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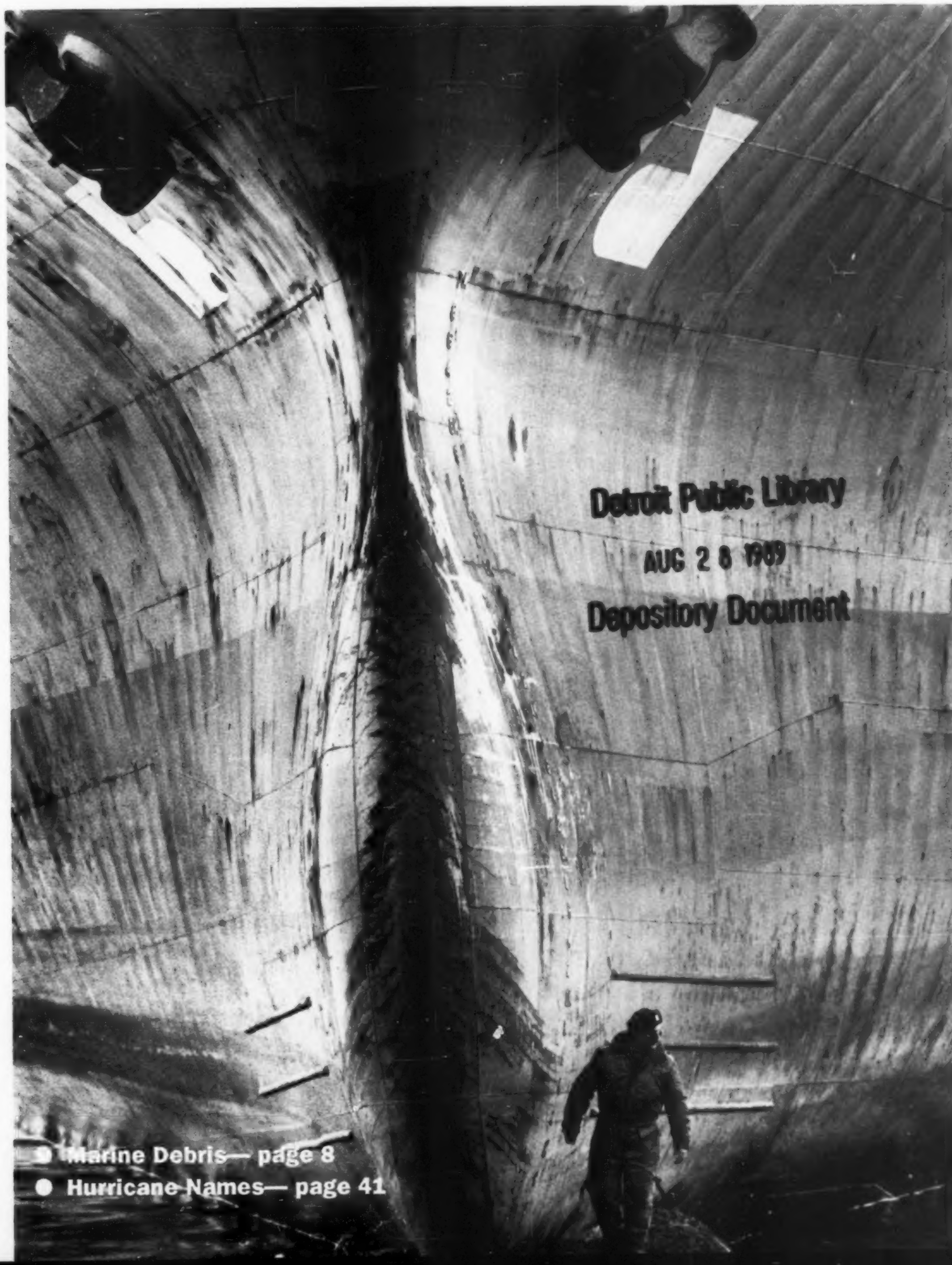
Mariners Weather Log

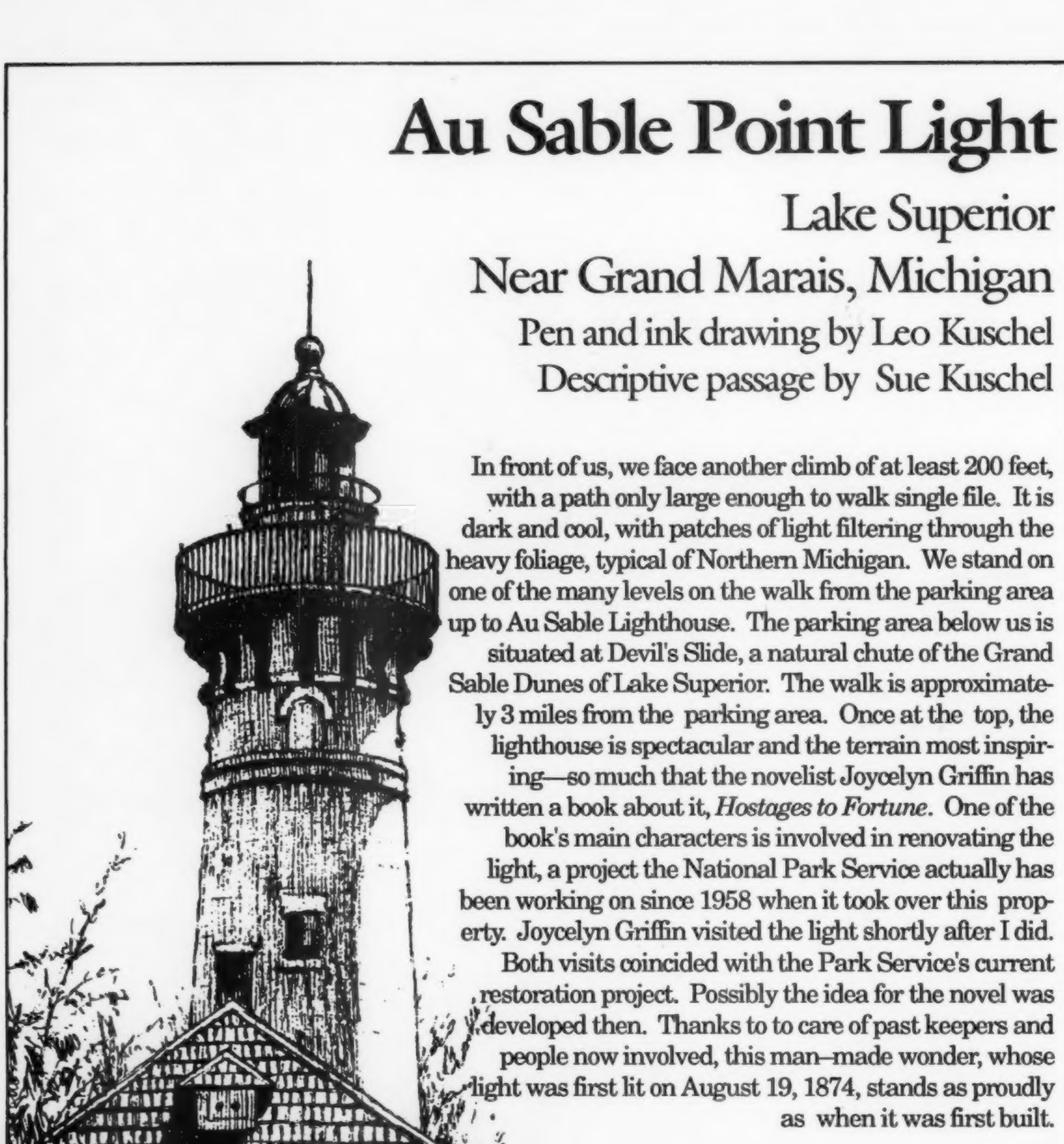


Au Sable Point Light

Lake Superior

Near Grand Marais, Michigan

Pen and ink drawing by Leo Kuschel
Descriptive passage by Sue Kuschel



In front of us, we face another climb of at least 200 feet, with a path only large enough to walk single file. It is dark and cool, with patches of light filtering through the heavy foliage, typical of Northern Michigan. We stand on one of the many levels on the walk from the parking area up to Au Sable Lighthouse. The parking area below us is situated at Devil's Slide, a natural chute of the Grand Sable Dunes of Lake Superior. The walk is approximately 3 miles from the parking area. Once at the top, the lighthouse is spectacular and the terrain most inspiring—so much that the novelist Joycelyn Griffin has written a book about it, *Hostages to Fortune*. One of the book's main characters is involved in renovating the light, a project the National Park Service actually has been working on since 1958 when it took over this property. Joycelyn Griffin visited the light shortly after I did. Both visits coincided with the Park Service's current restoration project. Possibly the idea for the novel was developed then. Thanks to to care of past keepers and people now involved, this man–made wonder, whose light was first lit on August 19, 1874, stands as proudly as when it was first built.

Historical Society of Michigan
2117 Washtenaw Av.
Ann Arbor, MI 48104

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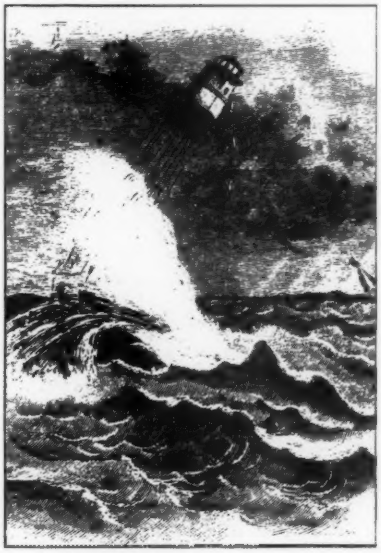
Features



The first Minot's Ledge Lighthouse was destroyed by a storm that became known as Minot's Storm of 1851.

Departments

Marine Weather Review

Cover: The ***Swallow*** drifted bow first onto Ulatka Head Beach in Dutch Harbor, AK. BM1 Dan Derwey checks sorbent snares around the cargo ship. See Marine Weather Review, North Pacific starting on page 50 for details of the rough Alaskan winter. The great U.S. Coast Guard photo was taken by PAC Ed Moreth.

Back Cover: This beautiful photograph reminds us that we are not alone in the use of the oceans. We are alone when it comes to polluting it (page 8). Photo by John Hyde, Oregon State U. Extension/ Sea Grant.

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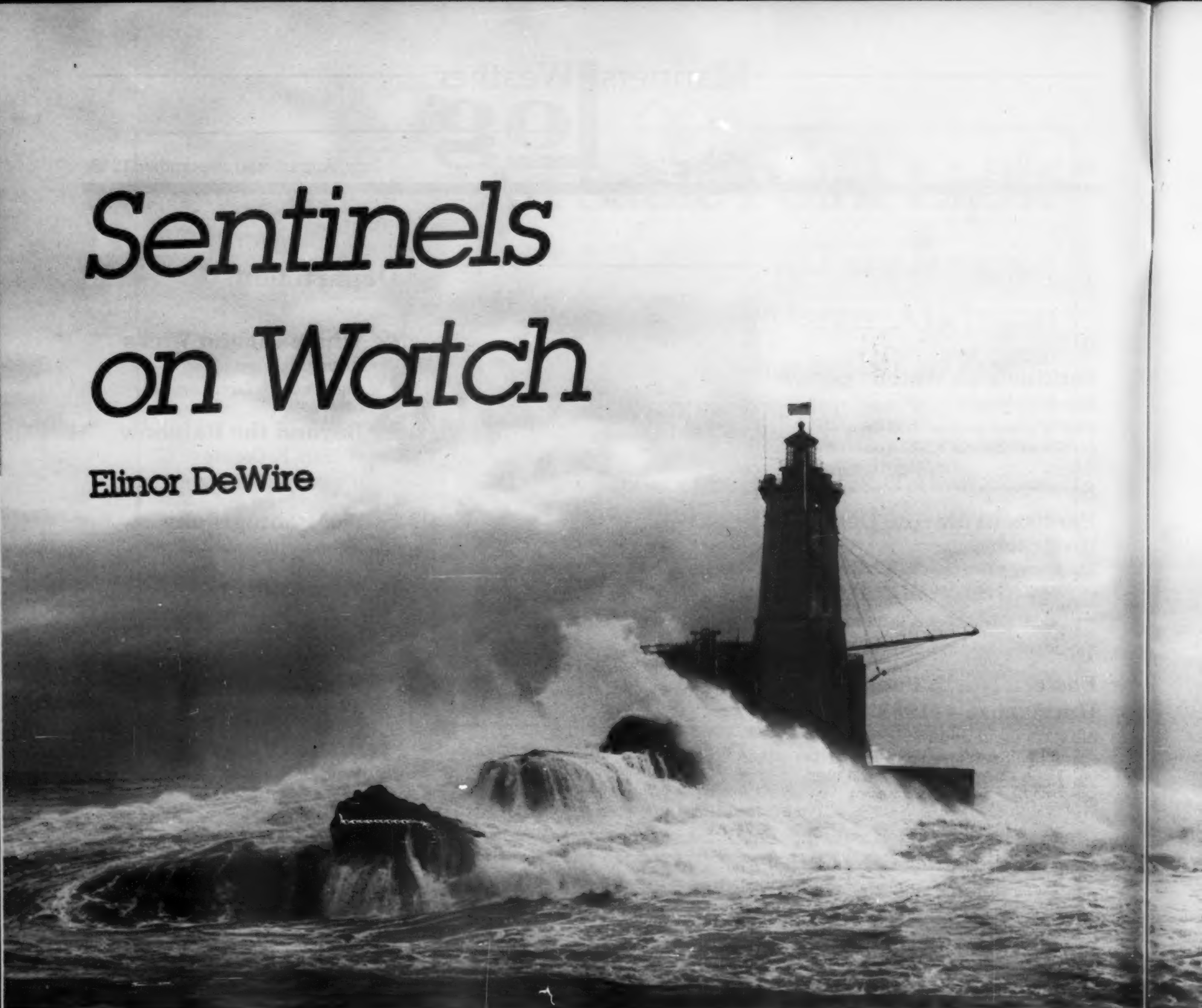
Sentinels on Watch

Elinor DeWire



This is the first of a two–part lighthouse history to celebrate the 200th Anniversary of America's Lighthouse Service.

Elinor, who authors our Whale Oil and Wicks column, is an expert on and lover of lighthouses. She has written more than 50 articles on the subject. Her lecture *Illuminating Experiences* has entertained audiences across the nation. She has also written a book — ***Guide to Florida Lighthouses***, published by Pineapple Press, Inc., Drawer 16008, Sarasota, FL 34239.

On August 7, 1989, the United States celebrated the 200th Anniversary of the Lighthouse Service. Officially, this benevolent organization has existed since 1789, when it was established under Alexander Hamilton in the Treasury Department. But lighthouses have been a part of the American way of life for much longer. In fact, there is considerable argument over just how to define a lighthouse, for we know beacons of all sorts have been used to guide vessels safely for thousands of years. And though not all of them embody the tall, conical form we traditionally imagine a lighthouse to be, such structures fulfill the same purpose—the concern for and safekeeping of human life.

Lighthouses exist in every geographic region of the globe to mark the oceans and inland lakes and the arteries feeding them. Their origin can be traced to antiquity, when crude fire beacons guided the first intrepid mariners. For centuries, a blazing brazier or hillside bonfire was the seafarer's only sentinel. Then about 450 B.C., plans for the world's first formal lighthouse were finalized, and construction of a titanic tower was begun on an island in the Nile Estuary at Alexandria. Its marble and limestone, quarried and dressed in the hills north of Giza, and purple granite taken from Assouan, were hauled miles overland and lightered to the island on huge rafts. No records indicate how long this monumental task took, but historians estimate the tower was probably under construction more than a decade.

The Egyptians were not the only ancient people to build sentinels.

When completed, the Pharos, as Ptolemy I named the magnificent sentinel, rose nearly 500–feet tall (the Washington Monument is 555–feet tall) and held a large brazier in its crown. Doubling as a temple, it was tended by priests who continually hauled wood up its massive courses to fuel the hungry beacon.

The mighty Pharos Lighthouse reigned over Alexandria Harbor until about 800 A.D., when its expensive beacon was deemed unnecessary. The structure stood another 500 years before being toppled by an earthquake, after which its island also eroded and disappeared. Thanks to ancient historians like Pliny the Elder, we have excellent descriptions of the Pharos Lighthouse, but even more recently, a diving expedition uncovered pieces of the collapsed structure buried in the silt of the Nile Delta. Mapping of the debris–fall and examination of some of its stones confirms Pharos size and appearance and justifies its claim as one of the Seven Wonders of the Ancient World. This great tower remains a part of history even today, having given its name to the modern–day study of lighthouse construction and illumination—pharology.

The Egyptians were not the only ancient peoples to build sentinels. Greece had several, including the Colossus, a 50–foot copper statue of Apollo straddling the entrance to the port of Rhodes and holding a flaming brazier in his hand. The Greek Heliespont and Sigeum in the Troad were also marked by lighthouses of sorts. The Romans built a lighthouse at Ostia around 50 B.C. and lit thirty others before their empire collapsed. All

An engraving from the 17th Century shows the Pharos of Alexandria, Egypt, considered one of the Seven Wonders of the Ancient World. (The others were the Hanging Gardens of Babylon, Colossus of Rhodes, Egyptian pyramids, statue of Zeus at Olympia, temple of Artemis at Ephesus and the Mausoleum at Halicarnassus.)

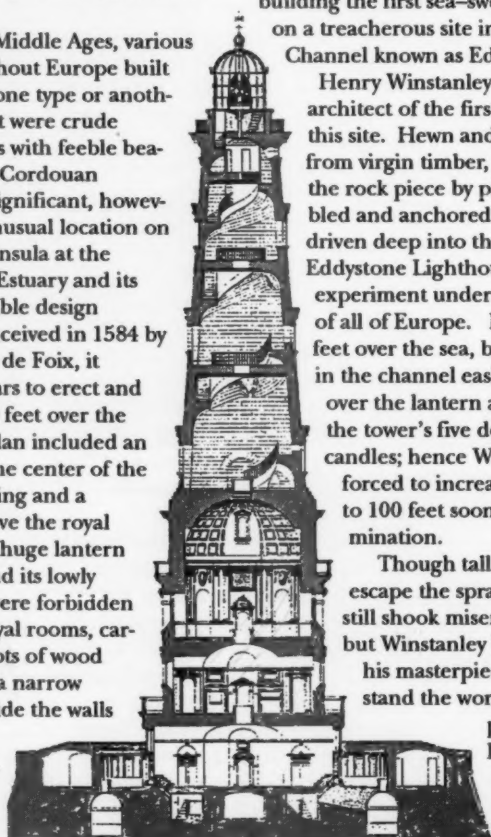
The Pharos was an imposing structure, built on a fortification–type base with walls rising about it. Tritons, gargoyles and other allegorical figures decorated each tapering story, and its interior was a beehive of religious and governmental activity. Rumor circulated among the other great civilizations of the time that the Egyptians had fashioned a huge mirror to intensify the light of Pharos' beacon. Adding credence to this supposition is the documented fact that the beacon could be seen more than 40 miles from Alexandria, suggesting some type of reflector system was used.

of these, save the Greek Colossus, were of stone or wood, had a predictable squareness to their shape, and held fire baskets aloft.

At the height of Roman rule, great beacons were built at Coronna, Spain and the harbor at Boulogne, France. Other lesser lights were raised but crumbled by the time of the Dark Ages, when, as their name suggests, no lighthouses were built.

In 1160 A.D., however, Italy re-illuminated the world with the great lighthouse at Genoa and hired, as its first keeper, one Antonio Columbo. His young nephew, Cristoforo, spent much time exploring the slender, stone lighthouse as a youth and grew to love the sea. Perhaps, by its sheer height, which elevated one's perspective of the horizon, Genoa Lighthouse influenced the course of history, for Cristoforo later sailed west from Genoa to prove a revolutionary claim that the world was a globe.

During the Middle Ages, various nations throughout Europe built lighthouses of one type or another, though most were crude stone structures with feeble beacons. France's Cordouan Lighthouse is significant, however, due to its unusual location on an erosive peninsula at the Gironde River Estuary and its elaborate, durable design (right). Conceived in 1584 by architect Louis de Foix, it required 27 years to erect and rose nearly 200 feet over the water. Foix's plan included an apartment in the center of the tower for the king and a chapel just above the royal chamber. The huge lantern burned oak, and its lowly keepers, who were forbidden to enter the royal rooms, carried their faggots of wood aloft by way of a narrow passageway inside the walls surrounding the lighthouse. The royal apartment was never occupied, however, and erosion has since sequestered the lighthouse far offshore from its original position.



In 1698 England revolutionized lighthouse construction by building the first sea–swept lighthouse on a treacherous site in the English Channel known as Eddystone Rock.

Up until the 18th Century lighthouses had been built on solid foundations, either onshore or on islands very near the shore, but much of the need for marking navigational perils lay offshore in the clutches of rocks, ledges, sandbars, and shoals. In 1698, England revolutionized lighthouse construction by building the first sea–swept lighthouse on a treacherous site in the English Channel known as Eddystone Rock.

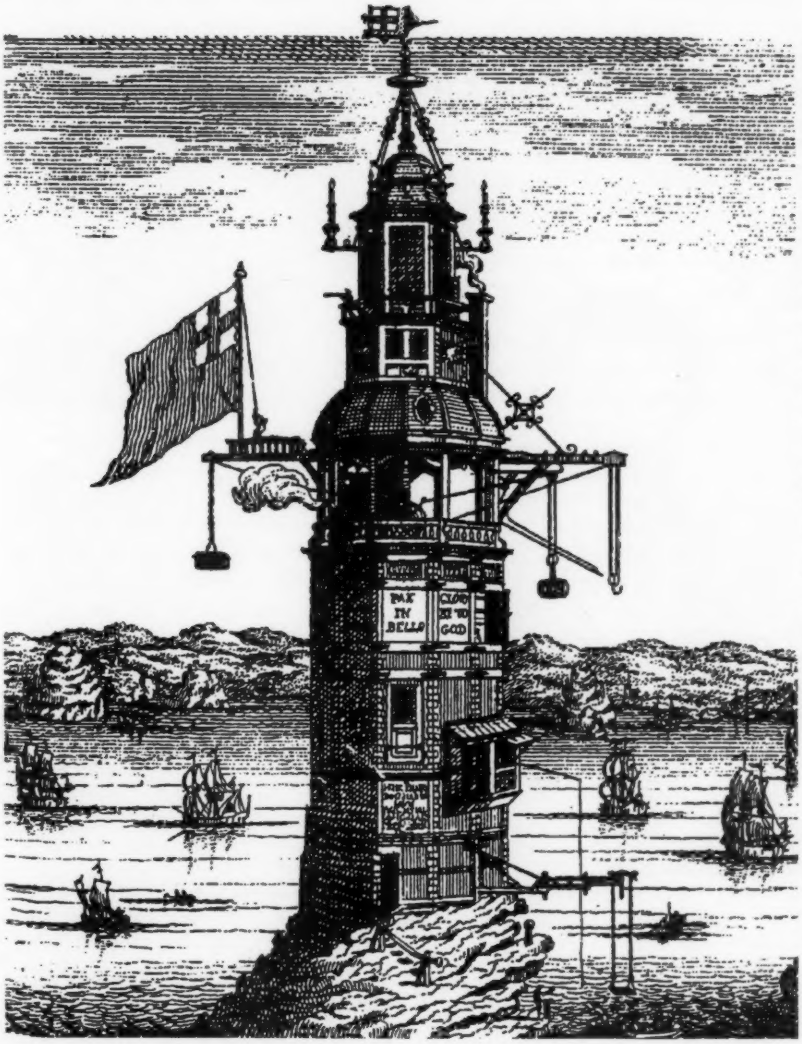
Henry Winstanley was the brave architect of the first sentinel on this site. Hewn and hammered from virgin timber, lightered to the rock piece by piece, assembled and anchored with iron rods driven deep into the rock, Eddystone Lighthouse was a bold experiment under the scrutiny of all of Europe. It towered 60 feet over the sea, but heavy waves in the channel easily sent spray over the lantern and snuffed the tower's five dozen tallow candles; hence Winstanley was forced to increase its height to 100 feet soon after its illumination.

Though tall enough to escape the spray, the tower still shook miserably in gales, but Winstanley boldly asserted his masterpiece could withstand the worst of the sea's pummeling. In 1703 after a storm mildly damaged the lighthouse, he confidently journeyed to the tower to make repairs. While work was still in progress at the beacon, a more severe storm blew in on the heels of the first and destroyed the lighthouse, killing Winstanley and his entire repair crew.

Three years later, British architect John Rudyerd began work on a new tower at Eddystone Rock. This one, built primarily of wood, was taller and stronger, due to its stone foundation and iron-sheathed interior. It was also considerably simpler in form than its elaborate predecessor, with a sleek design to provide minimal resistance to wind and waves. It suffered through several trying gales, then tragically met its end one night when the wooden lantern caught fire. The keepers fled down the wooden stairs and to the outer rim of the rock. As the lantern burned, its lead parts melted, and huge blobs of hot metal fell downward, splashing into the sea with a sizzle. One unfortunate keeper looked up at the blazing inferno, mouth agape, and swallowed a gob of the molten lead. He died a few days later at a mainland hospital from burns and poisoning.

Undaunted, the British called on civil engineer John Smeaton to build the fourth Eddystone Lighthouse. Against the advice of his colleagues, Smeaton chose masonry for his structure and adopted a conical shape that flared gently at the base and just beneath the lantern. This shape had the effect of minimizing contact pressure with waves and throwing them back upon themselves. His sentinel was lit in 1759 and stood for a century before being replaced by a taller structure. It was the first successful sea–swept lighthouse in the world and a harbinger of the great towers engineered in Europe and America over the next century.

While England was experimenting with sea–swept lighthouses, Scottish engineers were contemplating sentinels for their growing international trade. Scotland's jagged, rock–riddled coastline required strong masonry structures, many located on offshore islets or on submarine foundations. The Stevenson family, well–known marine



The first Eddystone Light (above) was an ostentatious affair, with numerous spires, flagpoles and decorative embellishments projecting from it. Boston raised the first Colonial sentinel in 1716 on Little Brewster Island at the entrance to the harbor. This 1729 engraving by William Byers shows a slender conical tower about 60 feet high. Records of the tower indicate it was a stone structure, white-washed and topped by an iron lantern in which oil lamps were burned.

engineers who had built numerous bridges, viaducts, breakwaters, and seawalls, were pressed into service for the Scottish Lighthouse Board.

Five generations of Stevensons — excluding Robert Louis Stevenson who gained fame as a literary figure — designed, built, and administered the great sentinels of Scotland. Among their most admirable achievements are the gargantuan towers at Bell Rock in the North Sea, Skerryvore in the Hebrides, and Dubh Artach off the Ross of Mull. Each of these sentinels is a marvel of marine engineering even today.

Unique obstacles faced the Stevensons at all three sites. Wave force at Skerryvore can equal three tons per square inch—an awesome assault to be sure—and Dubh Artach, though situated some 300 feet above the sea, has seen boulders thrown against its base by storm waves. Bell Rock, perhaps the supreme achievement in 18th Century architecture, once had one of its doors ripped off and imploded into the tower 60 feet above the waterline by the backdraught of a wave. In fact, Bell Rock Lighthouse has become such a legend among educators and historians, it is studied world–wide and utilized as a training post for novice lighthouse keepers, marine scientists, engineers and architects.

When the first colonists arrived in the 1600's, there was no welcoming light to guide them ashore ...

While England and Scotland were grappling with offshore construction, and France was perfecting better illuminants, the American Colonies were growing in both population and trade. When the first colonists arrived in the 1600s, there was no welcoming light to guide them ashore, but by 1716, Boston had raised the first Colonial sentinel on Little Brewster Island at the entrance to the harbor.

Elinor DeWire

It served until the Revolution when the British spitefully blew it up on their retreat from Boston. It was rebuilt and still stands today—active and among the nation's last manned lighthouses.

Along one stretch of New England coast... nine white lights were in view at once and mariners complained of difficulty differentiating them.

Numerous other Colonial lighthouses appeared before the Revolution. Most were located in New England, primarily in Massachusetts, but one was built in the South at Tybee, Georgia. Of those remaining today, only Tybee Light and Sandy Hook Light in New Jersey are original structures. Sandy Hook's tower, built in 1764, is in good condition and still acts as a navigational aid. It is an octagonal, brick tower with a base diameter of 29 feet tapering to a 15-foot diameter at the top. The lantern is of iron with a copper roof, and the entire structure rises 103 feet. It was built by Isaac Conro, and at 225 years of age, is a testament to his fine workmanship.

Because of advances yet to be made in the science of illumination, lighthouse architects and engineers in the 18th and early 19th centuries grappled with problems of identification. Along one stretch of New England coast, for example, nine white lights were in view at once, and mariners complained of difficulty differentiating them. This confusion was blamed for numerous wrecks and plotting errors and demanded a quick solution. Since optics had not yet been developed which could emit a characteristic signal, the problem was solved by the clever design of multiple light stations.

These consisted of double towers, often called twin lights. Such sites as Thachers Island, Massachusetts, Navesink, New Jersey, and Matinicus Island and Cape Elizabeth, Maine were given this type of system. Scituate, Massachusetts had, for a time, a creative foray into piggyback lights in one tower, and Nauset Beach, Cape Cod even had triple lighthouses. These elaborate systems proved cost–inhibitive and never gained general usage. In fact, not long after the first twin light stations were established in the United States, France introduced a revolutionary optic capable of producing a flash characteristic. This eliminated the need for multiple light towers, yet they continued in use until the 1920s, probably for sentimental reasons more than practicality.

In the next issue we will take a look at the evolution of American lighthouses.

Elinor DeWire

Scituate Light, MA (upper left) once had piggy back double beacons. Now it's a museum. Beavertail Light, RI (upper right) was a fog signal testing station and is the third oldest light in the nation. One of the triple lighthouses that once stood at Nauset Beach on Cape Cod (right) is now under repair by the National Park Service.

Elinor DeWire

Fresnel and His Lenses

The revolutionary lenses created by Augustin– Jean Fresnel significantly advanced the science of pharology. The design consisted of concentric rings of triangular cross–section, varying the overall curvature to produce lenses that required no reflectors to produce a bright parallel beam.

Today many people who drive trucks, vans or recreational vehicles are familiar with the Fresnel lens that is placed on the rear window of the vehicle. This allows improved visibility directly below and to the side. This is the guy you have to thank.

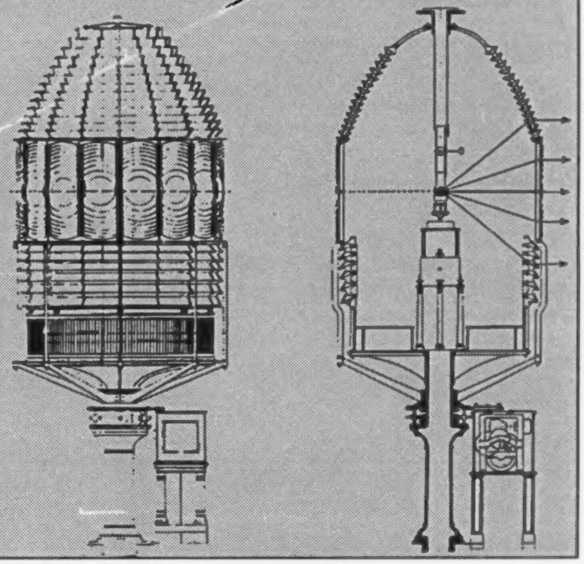
Fresnel was a French physicist born in 1788. His parents provided his early education but at the age of 12 he entered the École Centrale in Caen where he was introduced to science. In 1804 he entered the École Polytechnique in Paris intending to become an engineer. Two years later he went to the École des Ponts et Chaussées for a 3–year technical course, which included experience in practical engineering.

He served as a government civil engineer and worked on road projects in various parts of France. When Napoleon I returned from exile in Elba in 1815, Fresnel deserted his government post in protest. He was arrested and confined to his home in Normandy. Taking advantage of this, he developed theories on the wave nature of light.

Napoleon's return was short–lived and Fresnel was soon reinstated into government service under Louis XVIII. He concentrated in research into the various properties of light and made numerous experiments in the interference of light. Along with physicist Dominique Arago, Fresnel was first to demonstrate that two beams of light polarized in different planes do not exhibit interference effects. From this he correctly deduced that the wave motion of light is transverse rather than longitudinal (like sound) as had been believed. Fresnel was first to produce circularly polarized light. He also worked out a number of basic optical formulas including those for reflection, refraction, double refraction and the polarization of light reflected from a transparent substance. Fresnel's work in optical effects caused by motion of objects was input in the later development of the theory of relativity.

In applied optics, Fresnel designed the type of compound lens that was not only used to produce parallel beams of light from lighthouses, but was also adapted in a type of spotlight used for theatrical lighting. His scientific work was known only to a small group of scientists during his lifetime and some of his papers were not published until after his death in 1827.

Augustin–Jean Fresnel (above) was a notable member of the French Academy of Sciences and the Royal Society of London. Sketch courtesy of the Smithsonian Institution. The author's husband (left) is seen inside a fixed 2d order Fresnel Lens. A revolving 1st Order Fresnel Lens (right) is powered by clockworks.



On April 2, 1987 30 U.S. Senators wrote President Reagan to express their concerns over the growing problem of

Persistent Marine Debris

Part 1— The Threat

David Cottingham

During the summers of 1987 and 1988, medical wastes—including blood vials, syringes, and surgical paraphernalia—washed ashore along the East Coast of the United States.

Some of the materials were contaminated with infectious wastes, including the AIDS antibody and hepatitis virus. As a result, state and local officials closed beaches to recreational users for up to several weeks. In 1988, medical debris also washed ashore along the Great Lakes, prompting beach closures.

While receiving much publicity, these incidents are just the surface of a larger, potentially more devastating problem known as persistent marine debris.

Plastic debris in oceans, lakes, and coastal areas causes problems for wildlife and humans alike. Marine mammals become hopelessly entangled in lost fishing nets. Sea turtles die from ingesting plastic bags. Dead birds are found dangling from trees, entangled in monofilament fishing line.

Fishermen and other boaters lose thousands of dollars in fishing time and mechanical repairs when plastic debris wraps around propellers and propeller shafts, plastic sheeting clogs cooling water intake ports, and gill nets entangle vessels.

Experts are already grappling with the problem of what to do with plastics on land. But the marine debris problem, especially persistent plastic debris in our oceans and lakes, has only recently attracted significant attention.

David Cottingham, in the Ecology and Conservation Office under NOAA's Chief Scientist, served as chairman of the Interagency Task Force on Persistent Marine Debris.

What is it?

A lifeguard (opposite page) shows a syringe that washed up on Jones Beach, New York. Photo copyright New York Post. Debris (right) litters a New Jersey beach. Photo copyright Don Riepe, American Littoral Society (ALS).

Modern society uses a variety of petrochemical compounds commonly referred to as *plastics.* The qualities of plastics—strength, durability, ease of production and handling, low cost and being lightweight—frequently makes them preferable to other materials.

The day–to–day value of these handy compounds is obvious. Not so obvious is how best to dispose of them. They are dumped on land, buried in landfills, or jettisoned at sea, despite the fact some plastics will persist in the environment for up to 400 years.

As society has developed new uses for plastics, the variety and quantity of plastic items found in and near the oceans and the Great Lakes has increased dramatically. The most commonly reported products include bags, cups, bottles and six–pack yokes, milk jugs and tampon applicators. Even burst mylar and latex balloons add to the clutter. Industrial products include plastic sheeting, strapping bands, plastic parts, hard hats, resin pellets, gloves and fishing gear.

... bags, cups, bottles, six–pack yokes, milk jugs and tampon applicators.

Where does it come from?

The sources are many, and difficult to pinpoint. Debris blows, washes, or is discharged into the water from land. Sources include beach users, plastics manufacturers, processors and transporters, solid waste disposal facilities, combined sewer overflows and inappropriate or illegal dumping.

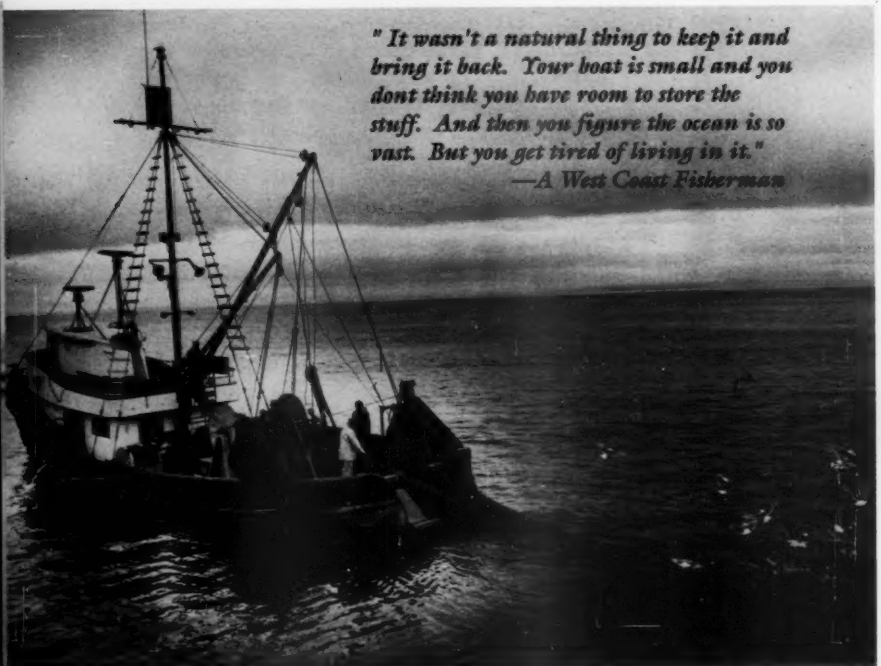
... merchant, military and research vessels; commercial fishing vessels, recreation vessels and offshore oil platforms and supply vessels.

Persistent plastic marine debris also comes from people at sea. Indeed, studies estimate that billions of pounds of ocean–source debris are dumped into the water each year. Among major contributors are merchant, military, and research vessels; commercial fishing vessels; recreational vessels and cruise ships; and offshore oil platforms and supply vessels.

Only a few kinds of debris can be traced easily to a single source, such as fishing gear to the fishing industry. Many items such as plastic bags, cups, and bottles could come from almost anywhere. Plastic sheeting is often used on fishing vessels, at construction sites, and aboard ships. Strapping bands, usually made of polypropylene, recycled polyester terephtalate, or nylon are used to bind items or wrap boxes.

In 1985 there were about 129,000 commercial fishing vessels registered in the United States— 24,300 weighed over 5 tons. The United States also

A National Marine Fisheries Service scientist (right) displays a trawl net fragment that was found near Yakutat, Alaska. Photo by John Thedinga, NMFS.



NMFS photo

mesh as they attempt to swim through the nets.

Trawl nets are bag–shaped nets that fishermen tow through the water. Trawl mesh sizes vary from about 11/4 inches for small shrimp to about 6 inches for cod. The nets are dragged at specific depths or along the bottom. As they move through the water, the nets may snag objects or become over loaded, causing loss or tears. Pieces of trawl nets frequently wash ashore in Alaska, and the Gulf of Mexico. Wood and net parts of crab and lobster pots are being replaced with plastic. Other plastic fishing gear, such as floats, net buoys, and ropes may become debris. Plastic bags and containers, which fishermen use for supplies of bait, ice and salt, are commonly found on beaches.

An estimated 16 million recreational boaters routinely sail the oceans, estuaries, or lower reaches of rivers that directly empty into coastal areas. These

Commercial Fishermen

issued about 550 permits to foreign fishing, processing, and transport vessels. All generate plastic garbage in two ways:

Intentional disposal

Many fishermen and other seafarers routinely discard their trash overboard, and are known sometimes to set more gear than they intend to retrieve.

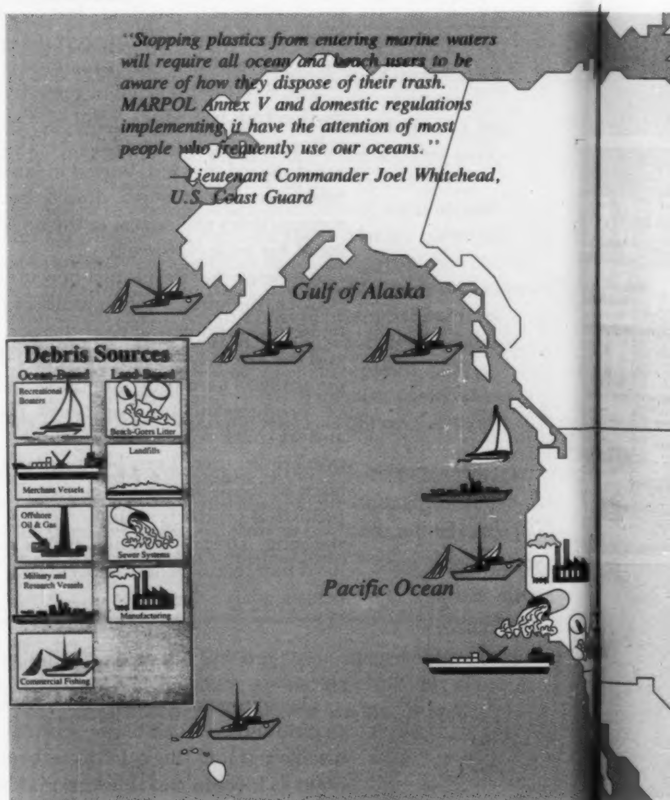
In addition, the U. S. Coast Guard has observed foreign fishermen cutting their nets loose to avoid being cited for fishing violations.

Unintentional loss

Gear wears out and breaks into pieces, and storms or equipment operator errors cause gear to break loose.

Synthetic line and nets replaced most natural fiber lines and nets during the 1960s. The new materials, which were stronger, more durable, and cost less in the long run, also persist longer in the environment.

Gill nets are fed into the ocean in the path of schools of fish. The nets hang suspended like huge underwater curtains. Gills of the fish get caught in the



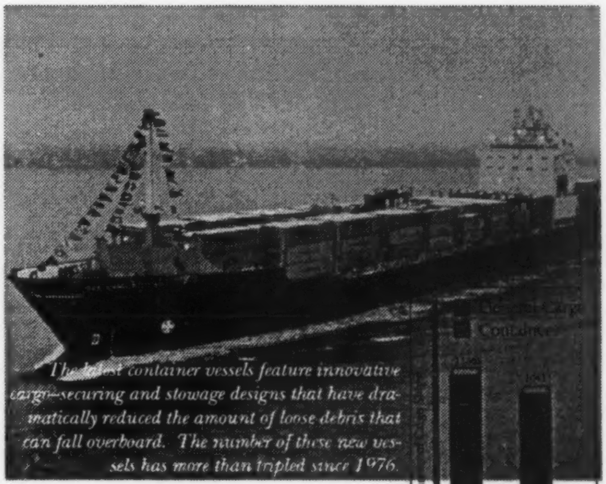
Recreational Boaters

boaters throw a variety of plastic articles—such as food wrap, beverage containers, bags, six–pack yokes, milk jugs and bottles into the marine environment. Both commercial and recreational fishermen leave monofilament fishing line in the water, especially when they clean out entangled reels or lose their line to snags.

Merchant Vessels

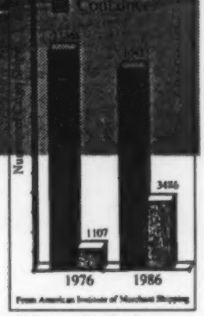
Merchant ships regularly take on supplies to last 2 to 3 months. Each seaman uses and disposes of an average of one plastic item every 2 to 3 days. Lloyds of London estimates there are approximately 71,000 merchant vessels worldwide. With about 25 people per ship, commercial transport vessels dispose of more than 500,000 plastic items each day.

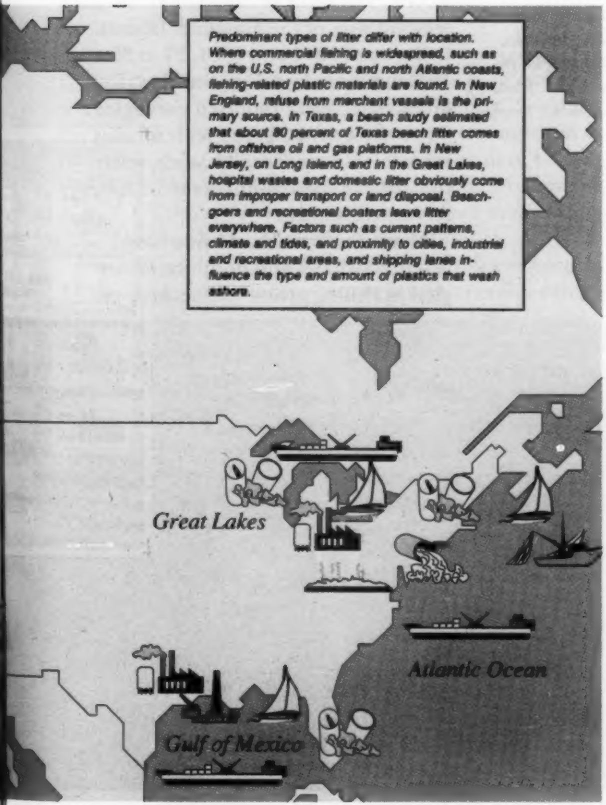
Two changes have occurred during the last 10 years that have helped reduce the amount of plastics entering the seas from merchant vessels. First, general cargo ships are being replaced by container ships. Container ships have less loose material on deck that might be blown or tossed overboard. Second, crew sizes have decreased from an average of 40 to 25 people per ship, which means less waste is generated.



The latest container vessels feature innovative cargo-securing and stowage designs that have dramatically reduced the amount of loose debris that can fall overboard. The number of these new vessels has more than tripled since 1976.

Sealand Corp. photo





Predominant types of litter differ with location. Where commercial fishing is widespread, such as on the U.S. north Pacific and north Atlantic coasts, fishing-related plastic materials are found. In New England, refuse from merchant vessels is the primary source. In Texas, a beach study estimated that about 80 percent of Texas beach litter comes from offshore oil and gas platforms. In New Jersey, on Long Island, and in the Great Lakes, hospital wastes and domestic litter obviously come from improper transport or land disposal. Beach-goers and recreational boaters leave litter everywhere. Factors such as current patterns, climate and tides, and proximity to cities, industrial and recreational areas, and shipping lanes influence the type and amount of plastics that wash ashore.

Military and Research Vessels

The U.S. Navy operates approximately 600 vessels worldwide carrying nearly 285,000 personnel. They dump roughly 4 tons of plastics into the oceans per day. The Marine Plastic Pollution Research and Control Act requires that public vessels stop disposing of plastics in the sea by 1993. Thus, the Navy is conducting research to develop ways to handle and store wastes aboard ships for up to six months between port calls.

Offshore Oil Rigs and Supply Vessels

In 1987, over 4,700 oil and gas platforms and several thousand support vessels contributed debris to the Gulf of Mexico. Debris on Texas beaches included plastic sheeting computer write protected rings, seismic markers, drilling pipe thread protectors, diesel oil and air filters, and deck light bulbs.

Threat to Wildlife

Marine debris affects wildlife in one of two ways— animals become entangled in it or they ingest it. When an animal becomes caught up in plastic debris it can strangle, suffocate, or exhaust itself. Some ingested plastics can block intestinal tracts, causing death.

Five groups of wildlife are most susceptible to injury or death from discarded plastic; marine and terrestrial mammals, birds, sea turtles, fish, and crustaceans.

Scientists monitoring the population of the northern fur seals (above) in the Pribilof Islands have documented that many animals, especially juveniles, become entangled in marine debris. Photo by B.E. Lawhead, courtesy of CEE.

Marine Mammals

Research was conducted on the northern fur seal population on Alaska's Pribilof Islands, to try to determine why the fur seal population had been declining 4 to 8 percent per year since the mid–1970s. Examination of harvested seals revealed scars from past entanglements, as well as seals with plastic debris still attached. The most common debris was fishing net fragments. Scientists speculated that such entanglements contributed significantly to the decline of the fur seal population and most entangled seals die before reaching their breeding grounds on the Pribilofs.

Hawaiian monk seals are highly endangered and number only 1,000 to 1,800 worldwide. They are particularly susceptible to buoy lines that mark spiny lobster traps, and net debris from high seas gill net and ground fish trawl fisheries in the North Pacific. This debris frequently washes ashore on the leeward side of the Hawaiian Islands.

Between 1974 and 1984, 27 to 35 Hawaiian monk seals in the Hawaiian archipelago were reported entangled. Since these endangered seals inhabit remote, seldom–visited islands, scientists believe these numbers to be a conservative estimate.

Many observers worldwide have reported whales and dolphins entangled in fishing gear— particularly gill

Gulls feasting on gill net catch, by Hank Pennington of the Alaska Sea Grant Marine Advisory Program.

nets and fragments of gill nets, and buoy lines used to mark lobster traps. As with seals, juvenile whales appeared to be more susceptible to entanglement than adults.

Birds

Virtually any bird that spends time at or near a large water body can be affected by plastic debris. Seabirds and shorebirds become entangled in active fishing nets, discarded nets, beverage container rings, and monofilament fishing line. This can lead to drowning, choking or lacerations.

There have been some reports of pelicans with beverage container rings and monofilament around their beaks, which prevented them from catching prey. Of greater concern is entanglement of monofilament around the wings and legs of pelicans and egrets. These birds can become further entangled in trees, where they die of starvation or exhaustion.

The tail of an endangered right whale with plastic rope around it is seen at left. New England Aquarium researchers have named the whale Necklace because of the rope, which has been around the tail for at least 8 years. Photo by Amy Knowlton, New England Aquarium.

Researchers have found plastic particles in the stomachs of approximately 63 of the world's 250 seabird species. Shearwaters and parakeet auklets, birds common in the North Pacific, show the highest rates of ingested plastic—as high as 21.7 particles of plastic per individual (short-tailed shearwater), according to a California study.

Resin pellets, generated by industrial processes, are the kind of plastic most frequently ingested by birds. Shear-waters, puffins, auklets, and murres eat these floating plastic beads, probably mistaking them for fish eggs or invertebrate prey.

Resin pellets and other plastics may be especially harmful to young birds that rely on regurgitated food from their parents during the first weeks of life. When an adult feeds resin pellets to young birds, the young may not be able to pass them. Therefore, their stomachs can fill with pellets, preventing them from obtaining adequate nutrition.

Sea Turtles

Five species of endangered or threatened sea turtles inhabit U.S. waters—Kemp's ridley, hawksbill, leatherback, green, and loggerhead.

The preferred habitats and foraging patterns of these sea turtles differ significantly. However, all can ingest or become entangled in plastic debris, which can reduce swimming efficiency, cut into soft flesh on its flippers, and cause a turtle to drown.

Sea turtles spend up to their first 5 years drifting with ocean currents. Young turtles often concentrate along lines of current convergence or at the centers of major current gyres, where food is plentiful. These areas, such as the Sargasso Sea in the Atlantic Ocean, are essential habitats for young turtles.

Young turtles sometimes mistake plastic debris for their favored foods, sargassum floats and invertebrates.

But these zones also collect marine debris—particularly plastic foam remnants, resin pellets, and floating nets. This debris intermingles with sargassum weed and other flotsam.

Young turtles sometimes mistake plastic debris for their favored foods, sargassum floats and invertebrates. The turtles also can become entangled in nets and line as they swim about in the sargassum weed.

Large leatherback sea turtles are pelagic and highly migratory. They subsist primarily on jellyfish. Researchers have found dead leatherback sea turtles with plastic bags and sheets in their digestive tracts. The leatherbacks probably mistook plastic sheeting for jellyfish.

Commercial and recreational fishermen use traps or pots to capture crustaceans such as crabs and lobsters, and also bottom–dwelling fish. Fishing pots, gill nets, and other gear can continue to capture fish and shellfish after gear is discarded or lost.

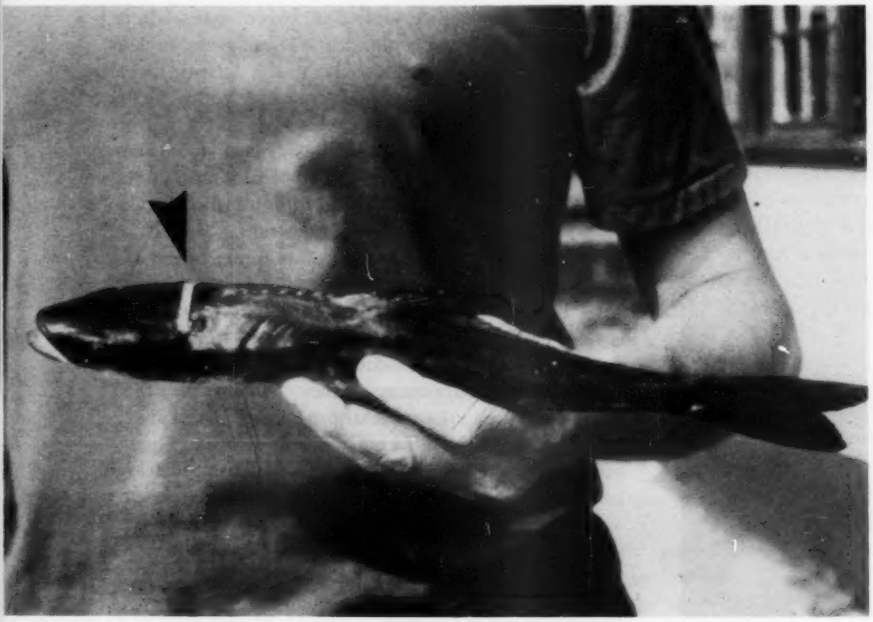
Fish and Shellfish

Even crab pots with escape panels prevent about 20 percent of legal size crabs and 8 percent of sub–legal crabs from escaping. In lost, baited pots, captured fish and crustaceans consume bait and die within several days, and they become bait for other predators. This cycle continues until the trap disintegrates, which may take several years.

The advent of monofilament gill nets enabled fishermen to string long curtains of nets in ocean waters. In the Bering Sea and North Pacific, salmon and squid fishermen from Japan use nets up to 25 miles long. The mothership salmon fleet within the U.S. Exclusive Economic Zone sets approximately 1,100 miles of gill nets each night during the 4–to 6–week salmon season. Observers aboard these fishing vessels estimate this fishery incidentally captures about 2,000 Dall's porpoises, thousands of pelagic seabirds, and other marine mammals each year.

Also, lost, free–floating gill nets are known to continue to capture target and non–target species. Even a small rate of net loss from such an excessive gill net fishery could produce substantial quantities of *ghost fishing* gill nets.

A cobia with a plastic band cutting into its body (below) was found by Department of Interior personnel at the Gulf Islands National Seashore, Mississippi. Photo courtesy of Department of Interior.



The Threat to Humans

Persistent marine debris can create hazards to human health in three ways. It can

- entangle skin and scuba divers.
- disable boats and ships.
- threaten public health if it contains contaminated materials such as medical wastes.

Persistent marine debris is a worldwide problem but it has not reached crisis proportions in most locations, so now is the time to act.

There are reports of divers becoming entangled in ghost gill nets and plastic lines. Fortunately, no diver fatalities in the United States have been attributed to entanglement in marine debris.

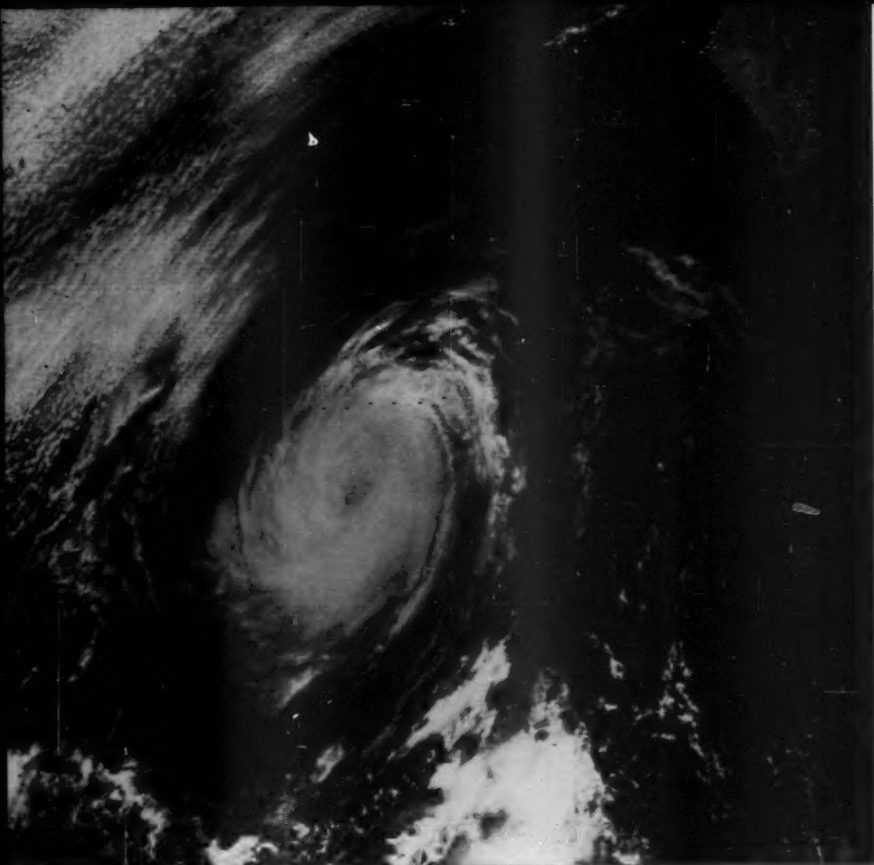
Beach litter knows no bounds. It can ruin the attractiveness of both developed and undeveloped shorelines. Since the economic well–being of many coastal communities and regions depends on a healthy tourist industry, beaches suddenly strewn with debris can seriously affect local economies.

Recognizing the negative economic consequences of cluttered beaches, many coastal communities have begun to spend millions of dollars each year to maintain clean beaches.

While the situation, as described here seems bleak, it is not hopeless. Persistent marine debris is a worldwide problem but it has not reached crisis proportions in most locations, so now is the time to act. There are many simple, common sense steps that mariners, fishermen, boaters and the general public can take to combat this problem.

Next issue: Part 2 — The Solution

The Alaska Sea Grant College Program provided the photographs and a wonderful brochure that was the inspiration for these articles.



Eastern North Pacific Hurricanes —1988

This basin became the National Hurricane Center's area of responsibility in 1988

Max Mayfield
and
Dr. Harold P. Gerrish

The six hurricanes that roamed the eastern North Pacific waters in 1988, pales compared to the eleven in 1985 and twelve in 1984. Only 3 years (1977, 1970 and 1969) in the past 23 years have seen less hurricane activity. Seven more storms this season reached tropical storm strength bringing the total named storms to 13, significantly less than the long term average of 16.

The first tropical cyclone of the 1988 season formed on June 15th but dissipated on the 18th without reaching tropical storm strength. The second formed on the 16th and became Tropical Storm Aletta the following day. The median date for the first tropical storm during the 22-year period 1966–1987 was June 2d. Although the Intertropical Convergence Zone (ITCZ) had been moderately active, with favorable upper air support over circulation embryos, the systems had difficulty in developing and thus the season began rather slowly.

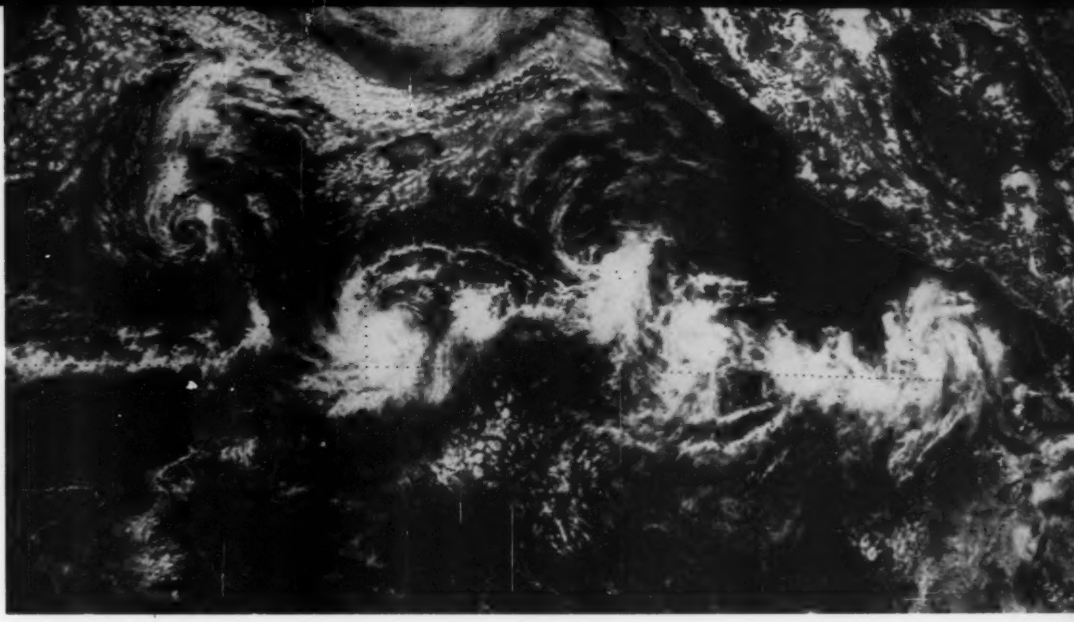
Once begun, the season became quite active in July, as in 1987, but dropped off significantly in September when the Atlantic was more active than normal. The National Hurricane Center assumed responsibility for both the Atlantic and Eastern North Pacific Basins beginning with the 1988 season, so the September respite in Eastern North Pacific activity enabled a smooth transition during the inaugural year. The season ended with the dissipation of Tropical Depression Miriam on the 2d of November.

There were 21 tropical cyclones (including tropical depressions) in 1988 of which 13 reached tropical storm strength and thus were named; 6 of those became hurricanes. The long term average is 16 named tropical cyclones with 8 reaching hurricane strength.

The 1988 season was active for 141 days, the shortest period since 1977 and 20 days below normal. The number of storm hours and the number of hurricane hours were below normal and represented the lowest number of such hours since 1980 and 1979 respectively. The remnants of three Atlantic tropical cyclones became tropical cyclones in the Eastern North Pacific

Max Mayfield and Harold P. Gerrish are Hurricane Specialists at the National Hurricane Center in Coral Gables, FL

Carlotta (left) was at minimal hurricane intensity on the 11th of July at 1901 UTC, southeast of Baja California. The series (right) from west to east includes TD Gilma, TS Fabio, TS Emilia, and TD Hector at 2046 UTC on the 30th of August. Fabio (below to the right)stands alone southeast of the Hawaiian Islands at 0116 UTC on the 3d of August.



basin. Tropical Depression Six in the Atlantic became Hurricane Kristy in the eastern North Pacific. Hurricane Debby in the Atlantic became Tropical Depression Seventeen–E in the eastern North Pacific. Hurricane Joan in the Atlantic became Tropical Storm Miriam in the eastern North Pacific.

None of the eastern North Pacific tropical cyclones moved onshore although several threatened to do so. Tropical Storm Aletta tracked within 50 nautical miles of the south coast of Mexico between Acapulco and Manzanillo producing heavy rainfall and local flooding in the Acapulco area. Unofficially, one person drowned in Acapulco. Tropical Storm Bud dissipated near Acapulco with no known deaths or damage. Tropical Storm Miriam (formerly Hurricane Joan in the Atlantic basin) raked portions of Nicaragua, Honduras, El Salvador, Guatemala and southeastern Mexico with heavy rainfall producing flash floods and mud slides. Damage estimates and fatalities associated with Miriam are not available.

Hurricane Carlotta, July 8–15

The first tropical cyclone of the season to reach hurricane strength formed in a tropical wave well to the south of Manzanillo, Mexico. As the developing system continued toward the west northwest, the upper–level outflow conditions improved and the fifth tropical depression of the season developed at about 2100 on the 8th. Tropical Storm Carlotta was christened at 1200 on the 9th.

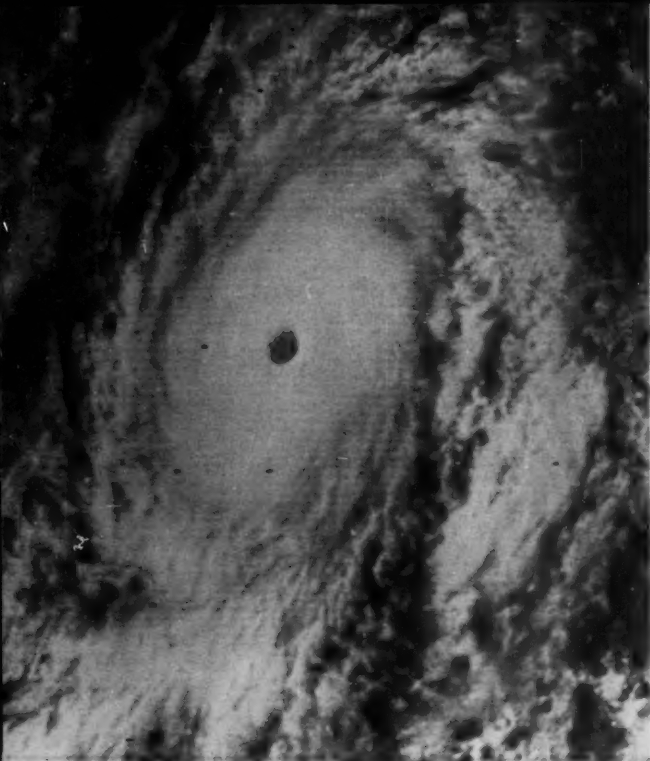
During the event, Carlotta was thought to be a strong tropical storm. However, after performing a post–season autopsy using satellite imagery, it was decided that minimal hurricane intensity was probably reached during the period 1200 on the 11th to 0000 on the 12th.

The favorable upper–level outflow conditions soon deteriorated and Carlotta was downgraded to a tropical storm at 0600 on the 12th and to a tropical depression 24 hours later, after losing most of its deep convection over cooler water. The depression then turned west southwesterly in response to low–level steering and eventually dissipated on the 15th.

Weather observations from the ***Kapitan Milovzorov and Bunga Sprigading*** were helpful in locating the center of Carlotta.

Hurricane Fabio, July 28 – August 9

The next hurricane began as an ITCZ disturbance, which became the eighth tropical depression of the season, 900 nautical miles southwest of the southern tip of Baja California. That position was farther south and west than most tropical cyclones this time of the year. The depression tracked on a general westerly course and was upgraded to Tropical Storm Fabio at 1800 on the 29th. The system steadily intensified reaching hurricane strength by 1200 on the 31st. Fabio reached its peak strength of 120 knots after crossing into the central North Pacific basin. Weather observations from the ***Orenburg*** as well as from the ***Professor Fedynskiy and Akademik A. Sidorenko*** were helpful in tracking Fabio.

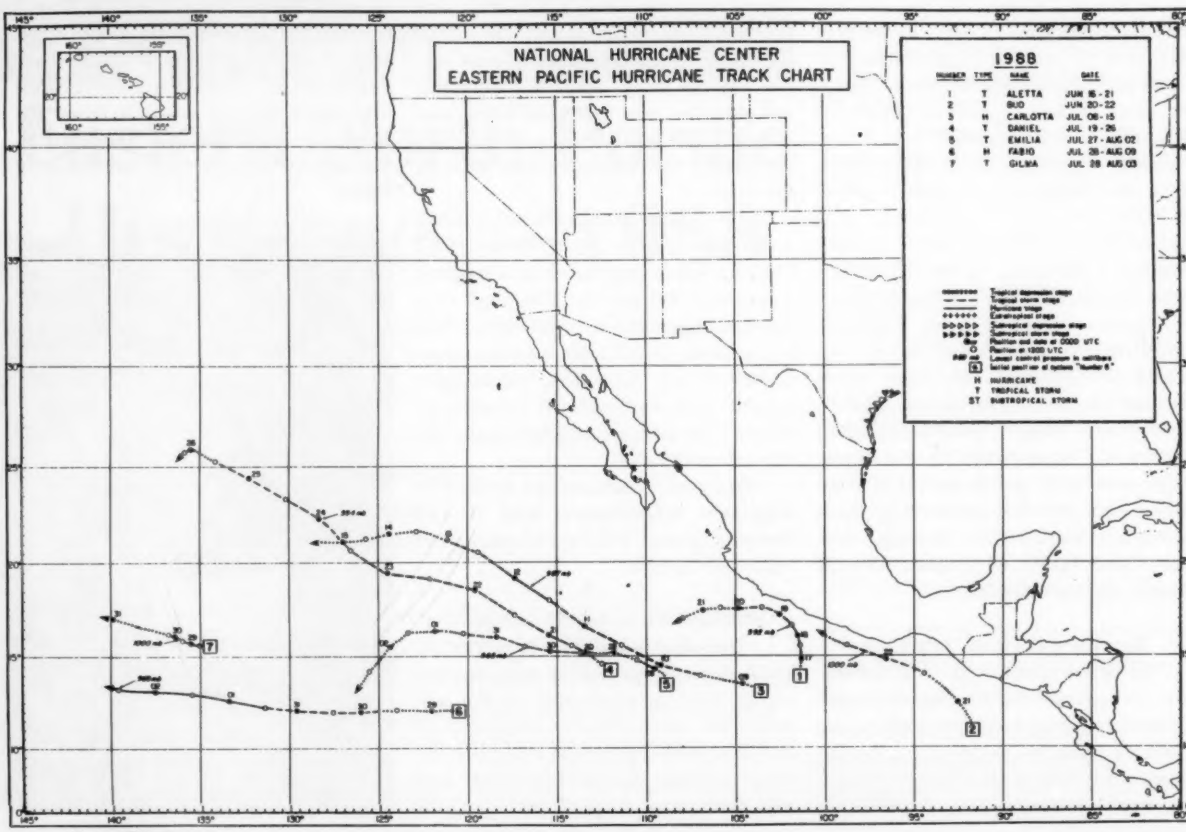


Hurricane Hector (left), the strongest storm of the season, poses at near peak intensity of 125 knots sustained winds at 2331 UTC on the 2d of August. The ***Ocean Highway, Vladimir Mayakovskiy, Omsk, McArthur, David Starr Jordan, Akademik Shirshov, Sugar Islander, Lairg, Akademik Shokalskiy, Taktik*** *as well as ships with call letters 3EXS, CBVN, PGAT, EAEI, UEIH, and 3FHI sent weather observations while in the vicinity of Hector. The persistent reports from the* **McArthur and David Starr Jordan** *were of particular value.*

Hurricane Hector, July 31 – August 9

The strongest hurricane of the season originated in an area of disturbed weather 400 nautical miles south of Acapulco, Mexico late on the 30th. A persistent ridge of high pressure to the north kept the system on a west northwesterly course for the next several days while strengthening. The eleventh tropical depression of the season was upgraded to Tropical Storm Hector at 1800 on the 31st and to Hurricane Hector at 0000 on the 2d of August. It reached its peak strength of 125 knots at about 0600 on the 3d.

The hurricane turned westward on the 5th, gradually accelerating while weakening. There was a period late on the 6th and throughout the 7th when Hector strengthened again but steadily weakened thereafter and finally lost its circulation on the 9th after crossing into the central North Pacific basin.



Hurricane Iva, August 5–13

The twelfth tropical depression of the season formed about 145 nautical miles south of the Oaxaca Province of Mexico at about 0000 on the 5th. The depression steadily strengthened while moving west northwestward and became Tropical Storm Iva 24 hours and Hurricane Iva 48 hours later. Iva turned northwestward and reached its maximum strength of 90 knots near 1200 on the 8th just after passing within 25 nautical miles of the island of Socorro. Socorro experienced a northeast wind of 40 knots with a minimum pressure of 999.5 mb and moderate rain.

Within the next 24 hours, Iva moved over 24°– to 25°–C sea surface temperatures and began to weaken. The hurricane was downgraded to a tropical storm at 0000 UTC on the10th and lost all deep–organized convection by midday. Thereafter, the tropical depression responded to low–level steering toward the southwest and dissipated on the 13th as a low–level swirl in the stratocumulus field.

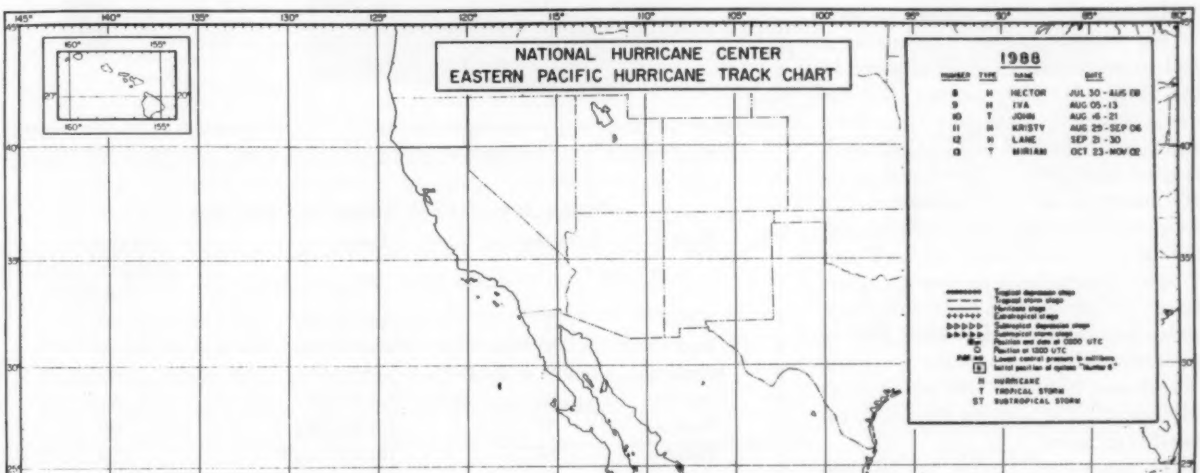
Weather observations from the ***Century Highway, Sea Navigator, Nedlloyd Kembla, McArthur, Triton Highway, Seville, Nerlandia, Pacific Teal*** as well as from a ship with call letters DPPA were useful in tracking Iva.

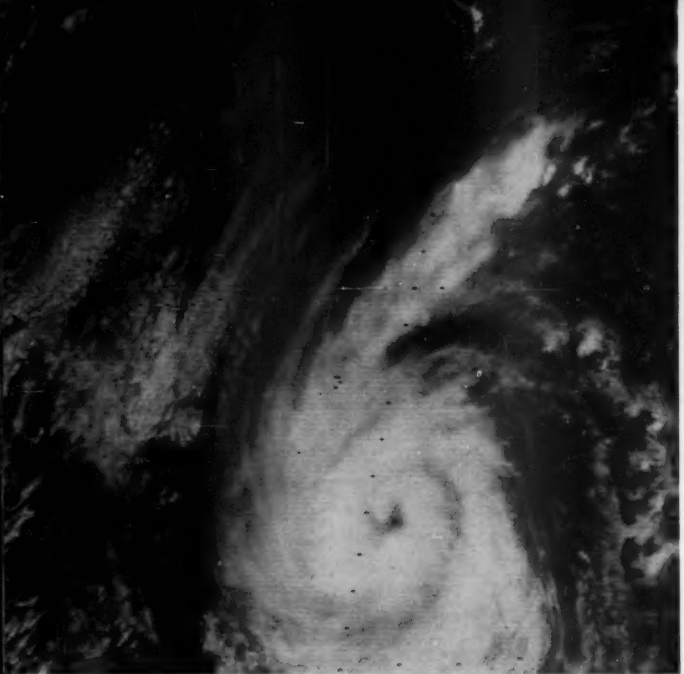
Hurricane Kristy, August 29 – September 6

The system that was to become Kristy started as the sixth tropical depression of the season in the Atlantic basin. It moved from the eastern Caribbean and into the central Carribbean before weakening and crossing over Central America with minimal convection. The convection reorganized and became the sixteenth tropical depression of the season in the eastern North Pacific basin, about 300 nautical miles south southeast of Acapulco, Mexico, at 0000 on the 29th. The depression was upgraded to Tropical Storm Kristy 12 hours later based on a ship report and satellite imagery. It reached hurricane strength by 0000 on the 31st and its peak intensity of 80 knots at 0000 on the 1st of September.

Kristy experienced strong shearing conditions and was downgraded to a tropical storm at 0600 UTC on the 2d and to a tropical depression at 1200 on the 3d. The system was devoid of deep convection. For the next 3 days it was represented as a well–defined circulation in the low–level cloud field. During that period the steering currents weakened and the depression looped and began drifting eastward before dissipating.

Weather observations helpful in tracking Kristy were sent from the ***Jongkong, Amanda Smits, Breekade, Nacional Sines, Pacduchess, Galion, Zim New York, Pacmerchant, B T Alaska, Sunbelt Dixie, Union Tokyo, Tian Shan Hai, Jinmu Maru, Pacific***





Hurricane Lane (left) is seen south of the Baja California peninsula on the 23d of September at 1931 UTC. Lane reached hurricane strength at 0600 and peaked after the photograph was taken, when maximum winds climbed to 90 knots around a 970-millibar center.

Mary Waardrecht, Dock Express, Ovanes Tumanyan, Neptune Ace, Geolog Pyotr, Maritime Star, Inger, Ocean Prawns, Bovec, Cheremkhovic, Akademik Yangel, Professor Fedynskiy, as well as ships with the call letters BEWX and HPAA.

This is the first annual summary of the eastern North Pacific to be done at NHC. We are glad to have their expertise not only for this report but most importantly for the hurricane warning system.

Bob Case, Gilbert Clark, Miles Lawrence and Jim Gross contributed to this report. Joan David drafted the track charts.

Pintail, Nedlloyd San Juan, E310, and the PGAT.

Hurricane Lane, September 21–30

The final hurricane of the season had its beginning as a disturbance in the ITCZ. By 0600 on the 21st the deep convection became organized and it was upgraded to the nineteenth tropical depression of the season about 300 nautical miles south southeast of Acapulco, Mexico. The low-level circulation became better defined and Tropical Storm Lane formed 12 hours later. Steady development continued with a pronounced upper-level outflow pattern evident on satellite imagery. Hurricane strength was reached at 0600 on the 23d with an eye visible on satellite imagery.

The upper-level outflow became disrupted by an advancing trough to the northwest of the center. The system began a weakening trend with Lane being downgraded to a tropical storm at 0600 on the 27th. By late on the 27th, nearly all of the deep convection had been lost and Lane appeared as a low-level swirl in the stratocumulus clouds over the cooler sea surface.

Weather Observations were received from the ***Sergey Yesenin, Bow's Brother, Century Highway, Jinmu,***

Monthly Summary of 1988 Tropical Cyclones

	May	Jun	Jul	Aug	Sep	Oct	Total
Tropical Depressions	0	1	2	2	2	1	8
Tropical Storms	0	2	3	1	0	1	7
Hurricanes	0	0	3	2	1	0	6
Total	0	3	8	5	3	2	21

Cyclones include tropical depressions and are ascribed to the month in which they began.

Summary of 1988 Tropical Cyclones

No	Name	Intensity	Dates	Maximum sustained wind (knots)
1	Aletta	T	Jun 16–21	60
2	Bud	T	Jun 20–22	45
3	Carlotta	H	Jul 8–15	65
4	Daniel	T	Jul 19–26	55
5	Emilia	T	Jul 27–Aug 2	60
6	Fabio	H	Jul 28–Aug 9	120
7	Gilma	T	Jul 28–Aug 3	45
8	Hector	H	Jul 30–Aug 9	125
9	Iva	H	Aug 5–13	90
10	John	T	Aug 16–21	35
11	Kristy	H	Aug 29–Sep 6	80
12	Lane	H	Sep 21–30	90
13	Miriam	T	Nov 2–23	60

T: tropical storm, wind speed 34 to 63 knots
H: hurricane, wind speed 64 knots or higher

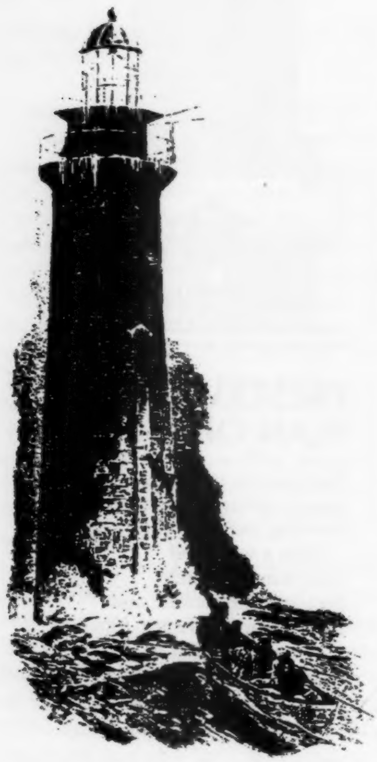
Dates begin at 0000 UTC and include tropical depression stage.

Minot's Ledge Lighthouse

Elinor DeWire
Mystic Seaport Museum
Mystic, CT 06355

A mile off Cohasset, Massachusetts is a forbidding ledge of granite that bares its sharp teeth at low tide. The Quonahassit Indians believed the evil demon Hobomock lived beneath this ledge. When he grew irritable, Hobomock roared to the surface and churned up a nasty storm. To appease him, the Quonahassits paddled out to the ledge at low tide and left offerings, which Hobomock greedily devoured when the tide rose.

The dark granite tower at Minot's Ledge has been awash for most of its career.



This view of Minot's Ledge Lighthouse came from ***Gleason's Pictorial****. This was the new lighthouse with a 114–foot tower, finished in 1860, which became known as* ***The Rock****. It has survived numerous storms during the past 130 years.*

A 97–foot, stone lighthouse stands over Hobomock's home today. Although it hasn't altered his mercurial temperament, its bright flash has kept ships away from his treacherous lair for over a century. Officially listed as Minot's Ledge Lighthouse by the Coast Guard, the beacon is affectionately called *Lover's Light* by smitten couples ashore. It's famous 1–4–3 flash in the dark seems to be an oath: *I love you.*

The dark granite tower at Minot's Ledge has been awash for most of its career. Built in 1860, it is considered a marvel of marine engineering. Its illustrious designer, Joseph G. Totten, was the first American to successfully build a masonry lighthouse on a wave–swept, offshore ledge. He borrowed his design from the British, who had built huge, offshore towers at such formidable spots as Eddystone, Inchcape, Skerryvore, and the Lizard.

This peculiar tower stood for less time than it took to build it and gave its name to one of the worst storms in New England history—The Minot's Light Storm of 1851.

But Totten learned more from his predecessor, William Swift, than from British engineers. Swift had designed and built the first Minot's Ledge Lighthouse in 1850. This peculiar tower stood less time than it took to build it and gave its name to one of the worst storms in New England history—The Minot's Light Storm of 1851.

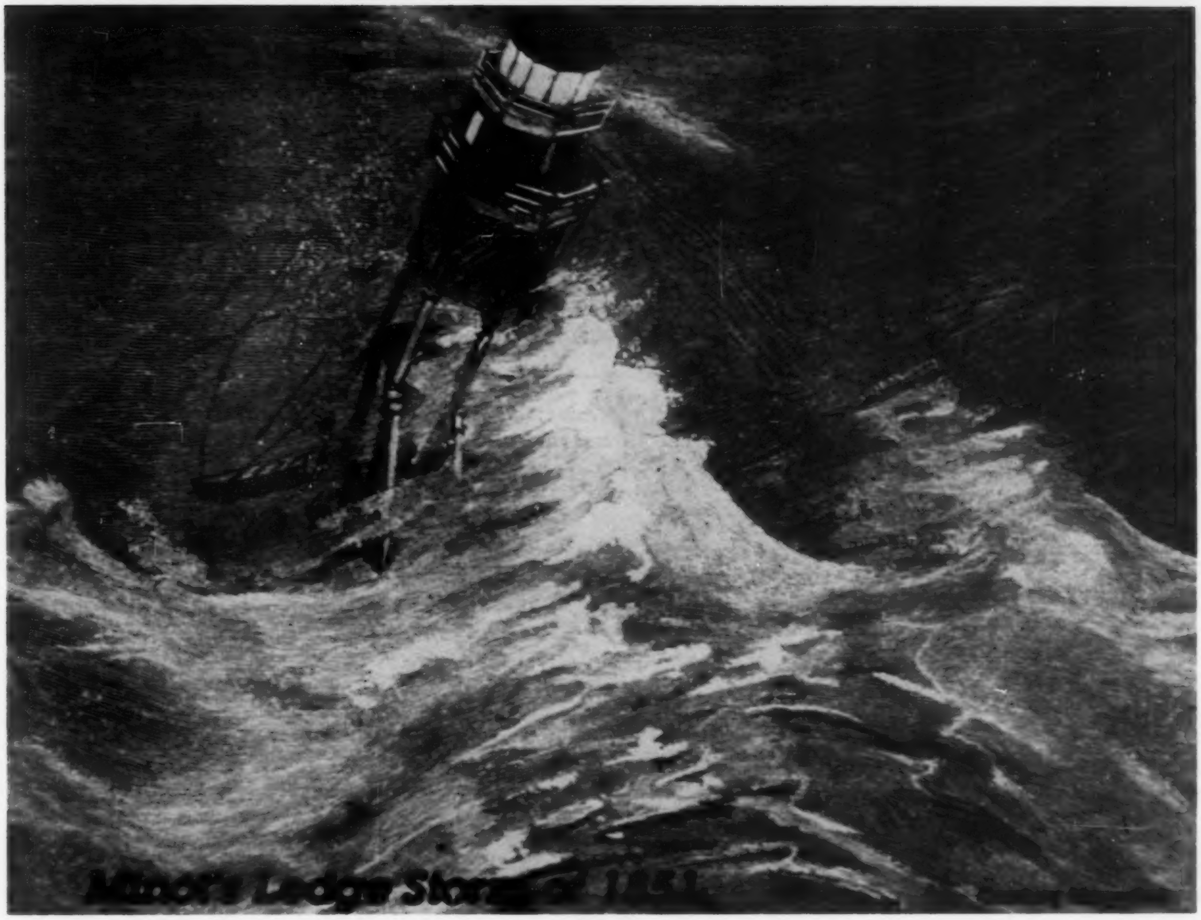
About a century before this costly storm, a colonial merchant named George Minot lost a valuable, cargo–laden ship on the ledge. Thereafter, the rocks were known as Minot's Ledge. Though the settlers of Cohasset did not believe in the demon Hobomock, they were respectful of Minot's Ledge.

Between 1832 and 1841 alone, it destroyed more than forty vessels. Merchants and seamen pressured the government for a beacon at this spot, since it lay very close to the shipping lanes of Boston.

Up until this time, the United States had confined its attempts to build lighthouses to onshore sites or rocks and ledges in protected areas. The British had developed several revolutionary designs for lighthouses on exposed,

National Archives

The original Minot's Ledge Lighthouse built in 1850 and lost the following year in a storm that became known as the Minot light Storm of 1851.



unstable sites. Captain William Swift, of the U.S. Army Topographical Corps, was sent to study Britain's offshore towers, then to examine Minot's Ledge and design a tower suitable for it.

...Henry David Thoreau... likened it to "the ovum of a sea monster floating on the waves."

Swift was impressed with the screwpile lighthouse, used in estuaries and bays. It was already being studied for use in the Florida Keys, and in the Chesapeake and Delaware Bays. Swift felt the screwpile's open framework design would offer less resistance to wind and waves than would a solid masonry tower. He also liked the idea of anchoring piles into the ledge itself.

Swift's plans were approved early in 1847, and construction began that summer. A schooner was tied up at the ledge to house workmen. They could work only at low tide, and with the ledge dry only 3 or 4 hours a day, the foundation proceeded slowly.

Eight holes were drilled in a circular pattern over the 25-foot ledge, with a ninth hole in the center. Each hole was 12-inches in diameter and 5-feet deep. The drilling machinery washed off the ledge several times before all nine legs of the tower were secured in their foundations with cement.

Atop the legs was hoisted a keeper's house with a 16-face lantern room. The result was perhaps the most peculiar lighthouse to ever stand in New England. When Henry David Thoreau passed it on his travels up the Massachusetts Coast, he likened it to "the ovum of a sea monster floating on the waves."

Shortly after 1:00 a.m. the iron legs of the lighthouse snapped like matchsticks, and it disappeared beneath the waves, taking its two keepers to their deaths.

On New Year's Day 1850 Keeper Isaac Dunham illuminated the strange tower for the first time. It's light was a long-awaited blessing to shipping, but within a month Dunham was convinced

the tower was unsafe. He requested it be strengthened with added cross –braces, but the government declined. As a result, Dunham resigned only 9 months after assuming his duties.

He was replaced by John Bennet who, after only a week at the lighthouse, also warned of its instability. Bennet noted that during gales dishes danced off the table in the kitchen, and the whole structure rocked and reeled "like a drunken man."

In April 1851 Bennet went ashore on business and left the lighthouse in the care of his two assistants. The following day a storm blew up and prevented Bennet's return. He watched from shore as the tower was pummeled by high winds and heavy waves, some so powerful they washed over the top of the 70–foot structure.

One keeper complained that the tower had "no corners"; another was killed when he fell from the top of the tower...; a third was driven to suicide after ice shut the tower door and trapped him inside.

The storm intensified as night approached, and Bennet feared for the safety of his assistants. Around midnight, the men began hammering on the fogbell in distress, but no one was able to help them. Shortly after 1:00 a.m. the iron legs of the lighthouse snapped like matchsticks, and it disappeared beneath the waves, taking its two keepers to their deaths.

Following the disaster, the steam towboat ***R.B. Forbes*** was moored off the ledge, and later the lightship ***Brandywine Shoal,*** to serve as beacons until a new lighthouse was built. Joseph Totten, Chief of Engineering for the United States, began to look at designs for a new tower. He was impressed with Britain's success with offshore masonry towers and determined that this was the most suitable design for Minot's Ledge.

Combining practical principles of offshore engineering, such as a foundation sunk directly into the ledge, the center of gravity as low as possible, and a tower that was smooth and sloping, Totten came up with a solid design that closely resembled the famed Eddystone Light of the English Channel.

The 114–foot tower took 5 years to complete. It was ceremoniously illuminated for the first time on the night of November 15, 1860. But the celebration was quickly marred by reports of strange happenings at the lighthouse.

The agony of serving at this wretched and desolate spot ended in 1947...

Its two new keepers heard tapping sounds in the tower and believed them to be the ghosts of the former keepers as it was known these men often signalled to one another by tapping on the stovepipe of the old tower. The lens and lantern were mysteriously polished on several occasions, and passing ships reported seeing a spectral figure clinging to the ladder at the base of the tower.

U. S. Coast Guard

Minot's Ledge Lighthouse as it stands today, a monument to Joseph G. Totten who designed and built this sturdy tower.

Haunted or not, a tour of duty at Minot's Ledge Lighthouse was like a sentence in prison. Keepers nicknamed it "The Rock," and many of them resigned their duties or were removed under strange circumstances. One keeper complained that the tower had "no corners"; another was killed when he fell from the top of the tower in the station lifeboat; a third was driven to suicide after ice sealed shut the tower door and trapped him inside.

The agony of serving at this desolate and wretched spot ended in 1947 when the Coast Guard installed automatic machinery in the lighthouse. Since then, the light has been visited only for periodic maintenance checks. Its damp, musty interior is occupied by spiders, and birds find its lantern a comfortable perch.

... the extraordinary achievements of its designer and builder were finally recognized almost a century after its construction.

In 1977, Minot's Ledge Lighthouse was made a national historic landmark by the American Society of Civil Engineers. Its uniqueness, and the extraordinary achievements of its designer and builder were finally recognized almost a century after its construction.

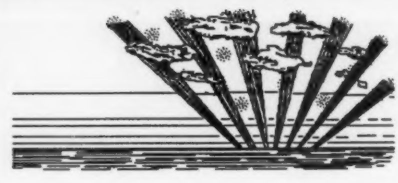
The Coast Guard made extensive repairs to the tower in 1987. It continues to operate and is a much–loved part of Cohasset's coastal scenery. Thousands of visitors peer across the waves at its hulking, gray form. Perhaps they view it with the mix of admiration and fear as Henry David Thoreau did in 1871: "The lighthouse rises out of the sea like a beautiful stone cannon, mouth upward, belching only friendly fires."

Port Meteorological Officers Conference

At the Maison Dupuy Hotel; bottom row, left to right: Jim Downing (PMO,New Orleans), Bob Webster (PMO,Long Beach), Pete Connors (PMO,Miami), Bob Melrose (PMO,Baltimore), Bob Collins (PMO,Chicago), Marty Baron (VOS Program Leader); middle row, left to right: George Smith (PMO,Cleveland), Pete Celone (PMO,Honolulu), Bob Novak (PMO,San Francisco), smiling Vince Zegowitz (Marine Observation Program Leader), Larry Cain (PMO,Jacksonville), Cliff Crowley (NWS Eastern Region), George Payment (Marine Meteorological Officer, AES, Canada), and Jim Nelson (PMO,Houston); top row, left to right: Richard DeAngelis (editor), Ray Brown (PMO,Norfolk) and Dave Bakeman (PMO,Seattle).

PMOs Meet in New Orleans

A training and coordination workshop for the Port Meteorological Officers was held in New Orleans this July 18–20th. It was hosted by Jim Downing the PMO for the Port of New Orleans. In addition to the U.S. PMOs, George Payment from the Atmospheric Environment Service of Canada represented the Canadian PMOs. Also attending was your editor and Cliff Crowley of the National Weather Service's Eastern Region. The conference was a huge success. While a good time was had by all, a great deal was accomplished, due to the able leadership of Vince Zegowitz, Marine Observation Program Leader. Marty Baron, the VOS Program Manager presented several briefings on new and updated programs. I have attended many conferences, over the years, but never have I been to one where everyone participated and so much was accomplished. Ideas were exchanged, procedures and methods reviewed. Topics included the VOS program computer data base system, new approaches to improving the timeliness and accuracy of ships' weather observations, the new VOS ship recognition program, new digital pressure standards for calibrating barometers and the Very Special Observing Project with the WMO. We also discussed technical problems connected with ship visitations, equipment loans and installation, weather report verifications and quality control. We're anxious to improve both the timeliness and accuracy of weather observations from aboard ship and suggestions from ships' officers are always welcome.

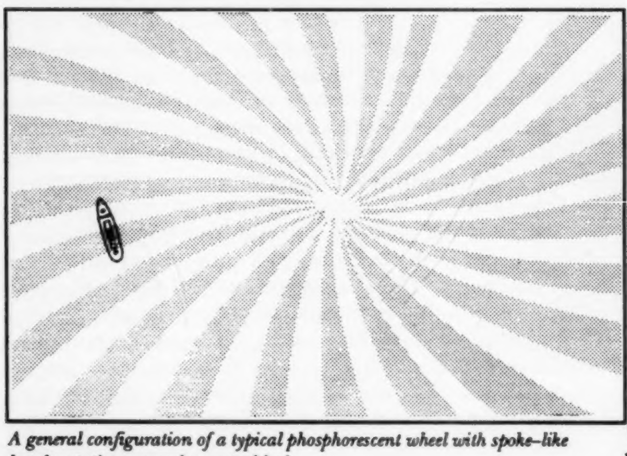


Phosphorescent Displays—2

William R. Corliss
P.O. Box 107
Glen Arm, MD 21057

There have been many sightings of long parallel bars or ripples of light moving swiftly across the sea at speeds of 50 to 80 knots. These luminous bands are usually 10 to 30 feet in breadth, separated by the same distance and anywhere from a few feet in length to several miles. Large variations exist in all dimensions. In one type of display, the bands came first from one direction for about 15 minutes, then ceased for several minutes and concluded with another 15 minutes of bands from a different direction. In other occurrences, the direction changes frequently. Parallel bands often precede and follow the wheel type of display.

Marine phosphorescent wheels are spoke–like bands of light rotating around a central hub. The spokes may be straight, curved, or S–shaped. Rotation is in either direction and may change during the display. In some cases, the outer part of the wheel seems to spin in a different sense from the central part. Illustrating the illusory character of the phenomenon, different observers sometimes see the same wheel rotating in opposite directions. Wheel sizes range from tens of feet to several miles, with spoke widths of 5 to 50 feet being common. Generally, the sources of light seem to be on or just beneath the surface, but several examples exist of wheels composed of luminous mist spinning well above the sea's surface. Spoke colors are whitish and greenish in most cases. Several wheels may appear simultaneously, rotating in various senses with overlapping patterns. Like the moving band displays, the phosphorescent wheels are most common in the Indian Ocean, especially the Persian Gulf, and the China Sea. The few wheel–like structures seen in other waters are usually poorly formed and stationary. The duration of a wheel–type display lasts from a few minutes to more than an hour.



A general configuration of a typical phosphorescent wheel with spoke–like bands rotating around a central hub.

Possible Explanation

Certainly bioluminescence is the most likely source of light, although observers frequently remark that the ship's wake is not luminous during wheel–type displays. The aerial wheels of luminous mist, if not illusory, would require air–borne organisms in cases where no wheel is visible in the water proper. Earthquake tremors may stimulate bioluminescence, with the interference patterns created by multiple sources accounting for the complex display geometries. The persistence of intricate geometries over many minutes seems to militate against this theory. The strong similarity of some marine phosphorescent displays to the so–called low–level auroras is striking. Some wheel observers have noted this, and electromagnetic forces should not be dismissed off hand. The illusion of high–speed bands is probably created by sequentially pulsing groups of luminous organisms; something akin to the moving patterns on a theater marquee. Just what initiates this cooperative biological action is a mystery, but some suspect the ship's radar or engine noise. It is interesting to note in this context that tropical fireflies put on spectacular rhythmic displays.

From the Marine Observer

October 23, 1954: Java Sea

"Numerous closely–spaced patches of phosphorescence, about 3 feet in diameter, were observed extending all around the ship to a distance of at least 1/4 mile. Each patch appeared to flash regularly at 1/2–second intervals. After 30 minutes the patches slowly increased in brilliance and bands of light were seen continuously during the subsequent 15 minutes, appearing as straight lines except for one short period when they seemed to radiate from a position approximately two points abaft the port beam, although no definite center could be seen. For most of the time the bands appeared to come from no definite direction, but were continually changing, staying in one direction for only short periods, and never coming from more than one point at a time. In the observer's opinion the bands consisted of closely

packed illuminated areas; they had the same frequency as the flashing of the separate patches, which remained visible throughout. The observer considers that the apparent motion was caused by the illumination of alternate bands."

Examples of phosphorescent wheels

April 5, 1953: Arabian Sea

"Commencing from about NNW, shafts of pale white diffused light appeared, apparently travelling on the surface of the water at a great speed. Each shaft was several feet wide and they stretched as far as the eye could see. At first they appeared in perfectly parallel lines, equally spaced, passing the ship at about one every second, but after five minutes they wheeled round in perfect formation and approached the ship from all points of the compass. They came from only one compass point at a time and each change of direction was swift and definite, though not abrupt. The most frequent directions were from NNW and SSE. After about 15 minutes the shafts occasionally formed into a rotating radial movement in which they retained their equal geometrical precision and the frequency of about one per second. At this time the pattern was continually changing about every 20 to 30 seconds from the parallel lines to the wheel. The periods of transition were hardly noticeable, nor were they abrupt. Each time the wheel appeared, it was in a different place. On one occasion there were two distinct wheels visible at the same time. Throughout the period the wheels appeared they varied in direction of rotation, some clockwise and some anticlockwise. Five minutes later the pattern became still more complicated but remained perfectly regular and at 2150 the light faded out over a period of 30 seconds. Although the light appeared to be on the surface of the water it was completely unaffected by the wind and no disturbance of the water was produced. The most notable feature of the phenomenon was the effortless speed and mathematical precision of movement."

April 24, 1953: Gulf of Thailand

"Faint flashes of light with oscillating movements were observed on the sea. The flashes gradually increased in strength until at 0230 they suddenly changed into rather intensive rays of light moving around centers lying near the horizon. Three groups of rays were present, as shown in the sketch. (A) One on the port bow having a bearing of about 300° with the rays rotating anticlockwise. (B) One on the port bow having a bearing of about 230°, rotating clockwise. (C) One on the starboard bow having a bearing of about 95°, rotating anticlockwise. The beams were curved with the concave side in the direction of the movement, and were passing the ship continuously with a frequency of about three a second; they looked more like glowing shafts than beams of light. Reflections on the ship were clearly visible....The phenomenon lasted till 0250, and it had been clear by the increasing strength of the group ahead and decreasing strength of the group astern, that the ship was advancing through the area of phosphorescence. Soon only the oscillating flashes could be seen and they also disappeared shortly afterwards. At 0300 the situation was normal again."

Three phosphorescent wheels turning simultaneously in the Gulf of Thailand; **A** *and* **C** *were rotating counterclockwise while* **B** *was spinning in a clockwise direction.*

March 6, 1980: Arabian Sea

"At 1552 GMT bioluminescence in the form of diffused white light in *whirlpool* and *cartwheel* formations was observed; within 3 minutes it completely encircled the vessel and extended to the horizon. The 'cartwheel' formations were brightest at the center with a halo effect surrounding the outer edges. As the vessel passed over two such formations the 'spokes' were estimated to be 2 to 2 1/2 metres in width and the entire concentration, which was more than the width of the vessel (approximately 27 metres), was observed on both sides of the bridge–wing simultaneously. The *whirlpool* formations, with a distinct central hub, varied from 1 1/4 to 2 metres in width and from 1 to 15 metres in length. The phenomenon was observed for 40 minutes."

Example of moving, parallel bands

March 27, 1976: Gulf of Siam

"At 1917 GMT pulsating bands of parallel light were observed in the sea moving towards the vessels from 045°T. After 2 to 3 minutes the bands took on a definite spoke formation, the center of which was not seen but lay in the direction of 315°T. The spokes passed the vessel at an ever–increasing rate, two spokes per second at the fastest. At this time they were about 22 metres in width and there was 22 metres between each spoke. The light given off from the spokes was white to light green in colour, it increased in intensity with the speed of rotation. The direction of rotation was clockwise. By 1925 the center of the spokes had shifted from 315° to 360°T and gradually reverted back to advancing bands of parallel light. Shortly after this, the parallel bands gave way to a counter–clockwise spoke rotation. This was observed in a direction centered along 315°T from the vessel; the spokes moved across the bow to 045°T, at which point they became parallel bands, which diminished in intensity. By 1934 they had completely disappeared."

The response to our new column was good. A number of photographs from the Great Lakes showed up. I hope we can continue to spur further interest in this wonderful hobby.

A Camera in Heat

Joseph John Spillman

Acacia Covered In Ice

Joseph John Spillman QM aboard the USCGC ***Acacia*** had this story:

"We anticipated foul weather ahead as the ***Acacia*** departed Great Lakes Maritime Academy, Traverse City, Michigan on 8 Feb 1989 enroute upper Green Bay for an ice breaking operation. The relative calm of Grand Traverse Bay did little to prepare us for the onslaught we faced as we cleared the lee of Leelanau Peninsula.

As ***Acacia*** rounded Lighthouse Point we faced 35–to 45–knot head winds and 10– to12–foot seas out of the northwest, the air temperature was 14°F. ***Acacia*** began accumulating ice almost immediately as freezing spray was driven across the bow. Visibility was reduced to 2000 yards due to heavy snow squalls. Upon entering pack ice, it seemed relatively calm. The winds, however, continued to blow at 30 knots. The temperature was dropping rapidly with a wind chill factor of nearly 50 below zero. All of us who were not on watch were given ax handles and told to dress accordingly. We began the removal of 12 or more inches of ice that accumulated during the night. We cleared the heaviest build–up to prepare for our passage home, but that story is for another time."

Joseph John Spillman

Icebreaking Duty

On March 28, 1989 several Coast Guard cutters, including the ***Mobile Bay*** and ***Katmai Bay*** (below), were used to break ice for a number of other vessels. The action took place near Saginaw Bay, MI. Two of the photographs (below and below right) were taken from the ***Barbara Andrie*** of Andrie Inc.

The ***Barbara Andrie*** (right) is seen from a helicopter, breaking a little ice for the barge she is pushing.

Care of Camera Equipment in a Hot and Humid Environment

Carrying a camera aboard ship often involves exposing it to climatic extremes. The hot and humid conditions of the tropics can present problems to both equipment and film. Film is sensitive to heat and the addition of humidity can decrease its ability to capture an image as well as hold an image that has been taken but not developed. It's a good idea to keep film in a refrigerator. A freezer is excellent for long term protection. Just make sure the film is at room temperature before loading.

Most modern medium and large format films are sold in heat-sealed packs which are resistant to moisture and humidity. Even the plastic containers that hold 35 mm films are packed to resist moisture. Common sense would dictate not to leave the film in the camera for extended periods and have it processed as soon as possible or keep in a cool, dry place. Silica gel is available in cans and bags and can help keep both film and equipment dry. Professional photographers sometimes keep their exposed film in a plastic bag with silica gel. Mold and fungus are other problems accelerated by heat and humidity, so a frequent inspection and cleaning of your equipment is necessary. Moderate heat around 90°F or so is not usually damaging to your equipment but in a confined area temperatures can build to 130°F or more and these temperatures can cause optical cement to soften or even melt. Keep cameras and lenses as cool as possible in hot weather.

Sinclair Shots

Edward Sinclair, Commanding Officer of the USCGC ***Biscayne Bay*** sent in several beautiful color photographs that he had taken during the past year. Sometimes color can make striking black and white shots, especially if there is a range of colors and contrast. The sunset was taken along the Detroit River. The rainbow, which actually showed up as a double rainbow, leads into the stack of the ***Biscayne Bay***. It was taken on Lake Huron. Captain Sinclair also had the opportunity to tow NOAA Buoy 45002 from Sault Ste. Marie, MI to Charlevoix, MI.

SOS and the Radio Officer

This is in answer to your column "Help for SOS".

It is ironic that you have a picture of the "Titanic" on the cover of your magazine, with an article like "Help for SOS" inside. "SOS" did not need any help. The system has worked very well for many years.

After the ***Titanic*** sank, world opinion demanded a system whereby any ship at sea could talk with any other ship, regardless of flag, country or language. Back then people thought that a nearby ship would be of more help than some coast station, hundreds or thousands of miles away. We have this system at the present time. After "GMDSS" is in place, we will no longer have it. The stage is being set for another ***Titanic*** disaster. Leading nations of the world will have GMDSS, third world countries will not. The time will come when some multimillion dollar ship is going to want to talk with some old third world ship that just went over the horizon, rather than with some shore–side station. They will be out of luck. Those in lifeboats will also wish they had the old system, which included a means of two-way communications for them. They also will be out of luck. ("EPIRB" should be an adjunct, not a substitute.)

It is difficult for me to think that a person in a position such as your's, could be as naive as you appear to be. Is it possible that the shipowners have been this effective with their smoke screen?

While it would seem that the possibility of hostilities has lessened, the threat of war is always present. In the event of a thermonuclear explosion in the stratosphere with its resultant "EMP", what will happen to all this GMDSS "Satellite Dependent" communications? Radio Officers will no longer be aboard. Even if an electronics person is on board, the system will be gone. (While "EMP" will wipe out solid-state gear, it has little or no effect on vacuum tube equipment).

Soon I will retire so this new system does not affect me directly nevertheless, I can't help but feel sorry for those who will follow both crew and passengers alike.

Yes, for certain, the shipowners and the manufacturers of this new equipment, will have their way. GMDSS will replace morse code ... in some cases, utter silence will replace morse code. Profits will increase and safety will decrease. When this happens, Mr. Editor, you can relax, knowing that you did your bit.

Very Truly Yours

John Ford/Radio Officer
SS Green Harbour

Hold on! *The GMDSS column was simply a press release from the U.S. Coast Guard. It does not reflect my opinion anymore than any other news item we publish. I admit to being naive about radio operations but I will never be anything but sympathetic toward and appreciative of the Radio Officer. That is why I published the column, in order to get feedback on what I know is a touchy area. I also have faith in the U.S. Coast Guard and believe their loyalties lie with the mariner and his safety. The reply to Mr. Ford's letter is from Joseph Hersey, Chief, Marine Radio Policy Branch of the U.S. Coast Guard.—ed*

Mr. Ford's response to your column "Help for SOS" and his concerns regarding disbanding the Morse–based system are legitimate ones. However, those developing the new system worked hard to overcome the problem he described.

We believe that the new system (the Global Maritime Distress and Safety System, or GMDSS) will be safer than the one it replaces for a variety of reasons. The GMDSS uses satellites, a very reliable and effective means of communications, but it doesn't totally rely on them. Ship–to–ship alerting on MF and VHF voice and a new system called digital selective calling is also included. High and medium frequency circuits, including telex, voice, and digital selective calling, are also major elements of the GMDSS. For example, we are modernizing and improving our HF telex stations, as many public coast stations have already done. Ships anywhere in the world can contact the U.S. Coast Guard (or other rescue authorities) immediately and reliably on HF telex, far more efficiently than they can on 500 kHz. The GMDSS treaty will require persons on vessels to be trained to use all of the GMDSS equipment. Procedures will also come into force to ensure that the equipment is properly and adequately maintained.

We can normally send an aircraft to reach a vessel in distress long before a nearby ship can reach him. In addition, we can alert other nearby vessels and direct them to a vessel in distress through the AMVER program and through safety broadcasts on NAVTEX or satellite links to GMDSS–equipped ships. Our operations center indicated that prior to INMARSAT, they had to rely on call tapes and radio calls in the blind to contact an AMVER participant regarding a nearby ship in distress. Now with INMARSAT, they can often dial the participant directly. They note that several recent cases have proved that capability to be a lifesaver!

The older Morse system has its disadvantages. It relies on, and is therefore

limited by, the need for another vessel or coast station, to be relatively close (on the order of 250 nm) to the vessel in distress. With the one-operator system on most vessels, an SOS probably won't be heard or detected unless it is proceeded by a relatively strong radiotelegraph alarm signal. Our experience with the survival craft "Gibson Girl" transmitter has been poor; calls are often undetected. Already approximately one third of cargo vessels (not U.S.) have obtained an "equivalency" arrangement with the International Maritime Organization allowing them to replace Morse equipment with other radio equipment which their administrations consider adequate for safety communications, but not necessarily as safe as the GMDSS. Adoption of the GMDSS should help to correct that problem.

Finally, the lesser developed countries did support the GMDSS when it was adopted as an amendment to the Safety of Life at Sea Convention last year. That Convention will require all the world's shipping subject to its rules, not just those of "leading" countries, to adopt the GMDSS. The GMDSS will, in our opinion, provide a safe, efficient, and cost effective way of providing better distress and safety communications for mariners.

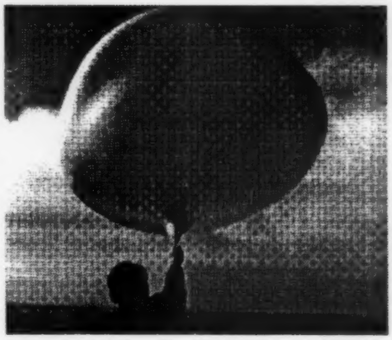
Sincerely,

Joseph D. Hersey, Jr.
Chief, Marine Radio Policy Branch
by direction of the Commandant
U.S. Coast Guard

Chicago PMO Receives Bronze Medal

Bob Collins, PMO in Chicago, IL, has received the Department of Commerce Bronze Medal fc - his improvements to marine weather services in the central Great Lakes area. Bob was sighted for advancing 3-hourly reporting schedules on the Great Lakes, which resulted in a big increase in open water observations on the lakes, from 3253 in 1986 to 9625 in 1988. He also developed a nearshore (out to 5 miles) reporting program in the south and west sides of Lake Michigan. In this program, a number of boats, mostly city owned, report weather twice daily—midmorning and mid-afternoon. Nearly 930 nearshore reports were received during 1988, for use in marine forecasting and warnings.

Bob has also made improvements to automated systems of the Chicago forecast office, by creating computerized forms and graphs. He also contributed to the hydrology program by installing river guages and maintaining monthly hydrological records. We congratulate Bob for his outstanding performance in these programs. Bob (below) received the award from NOAA Adminsitrator, William E. Evans.



Martin S. Baron
National Weather Service
Silver Spring, MD 20910

New Port Meteorological Office in Baltimore

The National Weather Service has established a new Port Meteorological Office in Baltimore, MD. This office will mainly provide service to vessels in the Port of Baltimore and the upper Chesapeake Bay, but will also cater to vessels in the port of Philadelphia and the Delaware River area. Mr. Robert Melrose(above), who was the Port Meteorological Officer (PMO) in Cristobal, Republic of Panama, for the past 13 years, will be the Baltimore PMO. The Panama office has been closed.

Cloud Identification Poster

Responding to requests from ships' officers, the National Weather Service is designing a new cloud chart. It will contain photographs and descriptions of all 27 cloud types recognized for real time reporting by the World Meteorological Organization (WMO). The chart will be organized by cloud level, or cloud base height (low or Cl, to 6500 feet, middle or Cm, to 25,000 feet, and High or Ch, to 60,000 feet), and will contain nine different cloud photos per level. It should be available from the PMO's by the middle of September, 1989.

New PMO in Oakland–San Francisco Bay Area

Mr. Robert Novak (below) has been chosen as the new PMO in Oakland, CA, replacing Jim Mullick who retired in January, 1989. Bob spent 21 years in the ..avy, retiring in 1979 as a chief aerographers mate. He has been with the National Weather Service since 1980, working in the observing and forecasting programs at Johnston Island and Colorado Springs, CO. Bob is a history buff, enjoys fishing, and hunting with a camera. He and his wife Barbara have 5 children.

Rogues Gallery

The photographs on this page and the next give us the most pleasure. These are the people who are the backbone of the VOS program and we like to let them know it in some small way. The presentations are made by the Port Meteorological Officers.

At the top left, David Bakeman, PMO, Seattle (right) presents a VOS award to Captain William T. Roffey (center) of the S.S **Great Land** *and Senior Port Engineer Larry G. Bickmore (left) of Totem Trailer Express, Inc.*

In the center photo, PMO Bob Webster from, Long Beach, (left) is presenting an Outstanding Performance Award to Captain Humphry of the M/V **Polynesia**. *Below left, Captain Tom Desjardins of the R/V* **Thomas Washington** *displays his VOS Outstanding Performance Award. At the top right, Trond Ingolfsrud Master of the* **Westwood Jago** *will be adding another paque to his wall. At the bottom right George Smith, PMO Cleveland, (left) is presenting the VOS Outstanding Performance Award to Captain John Allen of the* **Belle River**. *He is accepting the award on behalf of Captain Mike Elson, who was master during the 1988 season.*

Rogues Cont'd

At the top left Captain Raul Gomez Sarabia (left) of the B/M **Merida** *receives an Outstanding Performance Award from Jim Nelson, PMO Houston. Appropriately, in the center, the* **Top Ship** *during 1988 in the VOS program was the* **Moana Pacific**. *Shown accepting the award for exceptional observing support are second officer Armando Buenaventura (left), Captain Erland Jeppesen (center) and third officer Eduardo Paganpan. Congratulations!*

Below left Edward L. Barnaby (left) and Mike (Scuds) Szczudlo accept a certificate of appreciation for Calumet Marine Towing Service. They provide MAREP observations over southern Lake Michigan, and helped increase the number of observations from 11 in 1987 to 925 in 1988. At top right is the Chicago Police Marine Unit, who provide MAREP observations along the Chicago Lakefront. From left to right are Police Officers Kowalsky, Hehl, Meador, Marcianik, Eckstrom and Sgt. Silk. At bottom right the Beaches and Pools Unit of the Chicago Park District helped with the near shore forecast program by taking MAREP observations at selected beach locations. From left to right are Harry Gillespie, PMO Bob Collins, Ray Waldman (NOAA), Joe Pecoraro and Kirk Kliest.

New VOS Program Recruits

PMO's recruited 44 vessels into the Voluntary Observing Ship Program during the period April–June, 1989. Many thanks to these vessels for joining the program. Please follow the recommended reporting schedule as best you can, and remember to mail your completed observing forms Ship's Weather Observations, NOAA Form B–81, to your PMO in the yellow postage paid mailing envelopes. The PMO's send these to the National Climatic Data Center in Asheville, NC, where the data are archived on microfilm. This is why it is important to prepare these forms neatly—so they can be preserved for posterity.

New Recruits— April–June, 1989

AEL America	PCEL	Norton Lilly Co., Inc.
Alison Lykes	WMRJ	Lykes Bros. S/S Co.
Anders Maersk	OXIT2	Maersk Lines
Astro Jyojin	DVUL	Matson Navigation Co
Bebeouro	ELFN7	Rice, Unruh, Renyolds
Cape Henry	3EJI5	Lavino Shipping Co.
Carol	ELYF	OSL Shipping & Dev. Co. Inc.
Chembulk Clipper	ELHZ3	Maritime Management Corp.
Columbus Ontario	DHIP	T. Parker Host Inc.
Columbus Queensland	DICQ	T. Parker Host Inc.
Corwith Cramer	WTF3319	Sea Ed Assoc. Attn: Mr. Cheney
Docealfa	PPUZ	T. Parker Host Inc.
Ever Gallant	BKJN	Evergreen Int. (USA) Corp.
Faust	WRYX	INTNL Marine Carriers, Inc.
Hanjin Hong Kong	3EDJ5	Hanjin Shipping Co. Ltd.
Hansa Carrier	DEDS	Hanjin Shipping Co . Ltd
Hansa Star	LAJD2	Barber Ship Mgmt Ltd.
Hual Angelita	DVLT	Autoliners, Inc.
Hyundai Continental	D9RV	Hyundai Merchant Marine Co. Inc.
Itaite	PPDT	Norton Lilly Co., Inc.
Itanage	PPDH	Norton Lilly Co., Inc.
Japan Carryall	JRNO	Strachan Shipping Co.
Jeon Jin	D7H	Fritz Maritime Agencies
Louise Lykes	WLCV	Lykes Bros. S/S Co.
Magic	OWOG2	Brandtship USA, Inc.
Maritime Friendship	3FPP2	Lavino Shipping Co.
Mercury Ace	JFMO	Strachan Shipping Co.
Mindoro Sampaguita	DVFB	William Dimond and Co.
MSC Chiara`	IBKL	Containership Agency Inc.
MSC Sabrina	IBPA	Containership Agency Inc.
Nara	ONNF	N.V. Ubem S.A.
Nedlloyd Alkmaar	PCMM	Nedlloyd Lines
New Ruby	3FKF2	Cascade Shipping Co.
Oak Glory	ELB06	Oak Steamship Co. Ltd.
Ocean Australia	DPFE	Lavino Shipping Co.
Ocean Spirit	DPOH	Lavino Shipping Co.
Papyrus	DUWY	Matson Agencies Inc.
Pearl Ace	HOHB	Strachan Shipping Co.
Rani Padmini	ATSR	The Shipping Corp. of India
Saudi Abha	HZRX	U.S. Navigatrion, Room 200
Sea Commerce	DGZU	Southern S/S Agency Inc.
Sea Merchant	DHCO	Southern S/S Agency Inc.
Sunny Superior	DVHJ	Nippo Shipping Co. Ltd
Tayabas Bay	DZCO	Showa Marine Kogyo, Ltd

BATHYTHERMAL/TESAC Observations

Ships are reminded to use the correct format for Bathythermal/Tesac Observations. Bathys/Tesac should start with JJXX and end with the Call Sign.

EXAMPLE: **JJXX** 20106 0312/ 74519 05528 88888 00098 26097 28098 29094 33069 36044 37026 38014 39009 41004 46503 48505 59508 84512 9901 36512 37512 38512 39355 46355 0000 **VCTB**

Julie L. Houston
National Weather Service
Silver Spring, MD 20910

Meteorological Ship Observations

Ships are reminded to use the correct format for Meteorological Surface Observations. Meteorological Observations should begin with the Ship's call sign.

INMARSAT Format Example

WLXX 29003 99131 70808 41998 60909 10250 2021/ 40110 52003 71611 85264 22234 00261 31100 40803 ....

Coastal Radio Station Example

WLXX 2900399131 7080841998 6090910250 2021/40110 5200371611 8526422234 0026120201 3110040803

INMARSAT Reports Procedure

INMARSAT equipped ships may transmit weather messages using the following procedures after the message is composed off-line:

1. Select U.S. Coast Earth Station Identification CODE 01.
2. Select routine priority.
3. Select duplex telex channel.
4. Initiate the call.

Upon receipt of GA+ (Go Ahead).

5. Select dial code for meteorological reports, 41, followed by the end of selection signal, +.

   41+ (or 00 23 6715250+)

6. Upon receipt of our answerback, NWS OBS MHTS, transmit the ships call sign and the weather message only. Do not send any other preamble.

Selected Worldwide Marine Weather Broadcasts

The 1988 edition of **Selected Worldwide Marine Weather Broadcasts** is available from:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

The cost is $9.00. Please refer to stock number **003-017-00534-8** when ordering. If your vessel is in the VOS program you can obtain a free copy from a PMO.

Please send any changes to th publication **Selected Worldwide Marin Weather Broadcasts** to the followin address:

National Weather Service
International Telecommunications
Section W/0S0151 ROOM 419
8060 13th Street
Silver Spring, MD 20910

In addition addresses/ telephone numbers are needed to inform you of the next printing of **Selected Worldwide Marine Weather Broadcasts.** Our intent is to senc a letter to each of you, requesting that you provide us with updated schedules for the 1989 edition. Please send this information to the above address.

Available

Information concerning Coast Earth Statio ID codes and Telex and Telephone Countr Codes can be found in the INMARSA' Users Guide. The Users Guide is availabl at the address below:

COMSAT
MaritimeServices
950 L'Enfant Plaza, S.W
Washington, DC 20024

ATTN: James Jansco

Pride II Rescue

On Thursday, May 25, 1989, the ***Pride of Baltimore II*** had the opportunity to prove that she really is a goodwill ambassador. While enroute to Halifax, Nova Scotia, the first stop on her 4–month summer voyage, the Pride rescued two fisherman whose boat, the ***Miss Clara***, was taking on water and starting to sink.

Richard E. Hurley, Jr., a passenger on board the Pride, was able to provide this description of the rescue.

"Approximately 1:30 p.m. in the afternoon, several crew members heard a vessel calling the Canadian Coast Guard on the radio. The Coast Guard did not immediately respond and after several transmissions, the Pride crew heard the calling vessel give its position and repeat, "Mayday! Mayday!"

"As soon as the position was given, Patrick "Rico" Monaghan, the Pride's Third Mate, began plotting the position and notified Pride Captain Jan Miles when it was discovered that the

Pride was only 5 miles away. Captain Miles ordered crewmember John Fox to steer a course to the rescue.

"By this time, the Canadian Coast Guard had responded and Captain Miles notified them that the ***Pride of Baltimore II*** was enroute. All Pride hands were called on deck to prepare for the rescue.

"First Mate Mark Rosener and Second Mate Casey Fasciano directed the crew to get the Pride's Zodiac launch set to go in the water. Crew member Jeffrey Gottlieb, a qualified paramedic, prepared a cabin to handle any medical emergency.

" In the meantime, the Captain of the sinking fishing vessel radioed the Coast Guard that his boat was about 40% underwater and he and his mate were abandoning ship. At this point, they transferred into a life raft.

"As the ***Pride of Baltimore II*** approached through the fog, the red warning light on the life raft was spotted off the port bow. Captain Miles ordered the helmsman to steer to the left of the raft. When the raft was on the starboard side, Shane Jackson, the Pride's bosun, was lowered into the raft to assist the two fisherman as they boarded the Pride.

"The two fisherman were pulled on board and Captain Miles notified the Canadian Coast Guard of the successful rescue. The Pride was directed to proceed to the port of Lunenburg".

Richard E. Hurley, Jr.

*A last look at the Miss Clara (left) as she sank off the coast of Nova Scotia on May 25, 1989. Her Captain and mate were rescued by the **Pride of Baltimore II**, which was only 5 miles from the **Miss Clara** when the fishing vessel notified the Canadian Coast Guard that it was sinking. The new **Pride of Baltimore II** (above) is on a goodwill tour and was headed for Montreal after her stop in Nova Scotia.*

Lightning Hazard

Lightning killed 68 people in 26 states and injured 283 others last year. Based on the 20-year average, lightning claims 88 deaths each year.

Nearly 70 percent of last year's lightning deaths were reported by eleven states. They included: Florida with nine deaths; six in Colorado; four each in Georgia, Michigan, New York, North Carolina and Wisconsin; and three each in Minnesota, New Mexico, Texas and Virginia.

Some 46 of last year's 68 lightning deaths occurred in the open or under trees. Three other victims were on a golf course and another three died in boats.

The danger of talking on the telephone during a thunderstorm was demonstrated again last year when lightning killed a woman in Montezuma, NY, while she was using the telephone. Seven other people in six states were injured by lightning while talking on the telephone.

Jayhawk

The U.S. Coast Guard has designated the name Jayhawk for its new HH-60J medium range helicopter. The first of 32 planes will be delivered in March 1990.

The nickname refers to the fictitious bird that represents the boldness of the pioneers who settled the state of Kansas.

The name was chosen through a service-wide "Name the Helicopter" contest. Marine Science Technician 2d class Janice Silves, stationed at the Marine Safety Office in Huntington, WVA, submitted one of five winning entries and was declared the winner after a drawing to break the tie.

The HH-60J, designed to meet the medium range mission, is capable of flying 300 miles off shore, remaining on scene for 45 minutes and hoisting 6 people, then returning to its point of origin with a safe fuel reserve.

Coast Guard Auxiliary

The Coast Guard Auxiliary, a volunteer, non-military organization authorized by Congress just prior to World War II, celebrated its 50th birthday on June 23d.

Auxiliarists help the Coast Guard with search and rescue duties, operate radio stations, perform courtesy marine examinations, teach boating safety classes, and go on patrols with Coast Guard units. They are trained and administered by the Coast Guard. Last year Auxiliarists responded to 9,394 calls for help, assisted 27,131 people in distress and saved 458 lives.

Auxiliaries also verify the proper placement of private aids to navigation, ensure that navigation lights on bridges are working properly, help update charts, assist with Coast Guard recruiting, and visit marine dealers to promote boating safety.

Membership is open to U.S. citizens over 17 years old, who own at least 25 percent of a boat, airplane, or marine radio station, or have special skills needed by the organization.

NOAA Tracks Oil Spill

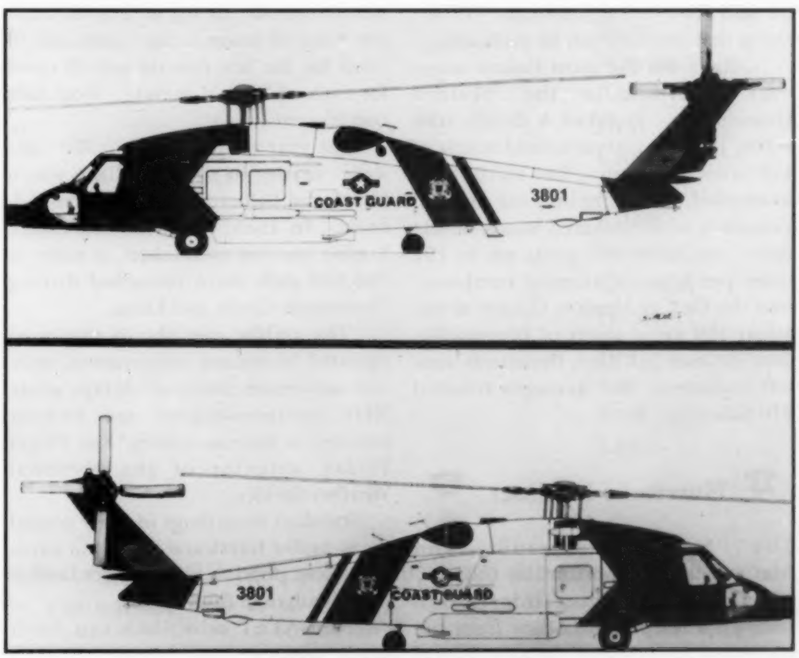
When 10 million gallons of oil spilled into the inlets of Alaska's Prince William Sound, Debbie Payton, a NOAA oceanographer, responded.

Thanks to an agency-developed computer modeling program dubbed *Awesome*, she could predict with grim accuracy where the viscous mess would spread.

Payton could also use another module of the program, On Scene Spill Model (OSSM), to calculate the chances that the oil would contaminate sensitive areas that contain salmon hatcheries or herring spawning sites.

"We identified the target area and then essentially ran the program backward to determine the possibilities of the oil moving from where it was to other sites," Payton said.

This capability gave Exxon, NOAA and the multiple-agency task force headquartered in the town of Valdez, advance warning of where still-scarce equipment such as oil containment booms and skimmers needed to be deployed.



HH-60J Jayhawk

Hurricane Season

During the hurricane season, which in the North Atlantic runs from June through November, ships' weather reports are particularly valuable. While weather satellites are generally considered the first line of defense against hurricanes, they cannot provide the detail that a timely ship report can. During this season, GOES central (Geostationary Operational Environmental Weather Satellite) is doing double duty so reports are more valuable than ever.

Dr. Robert Sheets, Director of the National Hurricane Center, warns that: "If a major storm strikes a coastal metropolitan center this year, the risk of fatalities is high because the endangered population will face congested evacuation routes, insufficient escape time, and too little experience in hurricane survival."

Sheets said that "based on a 20-year average, hurricanes claim 30 lives in the United States each year.". However, he said "last year's Hurricane Gilbert shows that averages can be misleading."

Gilbert was the most violent storm ever recorded in the Western Hemisphere. It raked a deadly trail across Jamaica with sustained winds of 123 miles per hour. The storm then intensified, slamming into the Yucatan Peninsula with sustained winds of 184 miles per hour and gusts up to 199 miles per hour. Churning northward into the Gulf of Mexico, Gilbert struck about 100 miles south of Brownsville, Tex. At least 318 died, thousands were left homeless, and damages totalled $10 billion.

☎ Hurricane Hotlines ☎

The National Oceanic and Atmospheric Administration (NOAA) will provide hurricane information through a telephone hotline from the National Hurricane Center, Coral

Gables, FL, where all hurricane activity is monitored.

The hotline will be activated during hurricane season (June 1 through Nov. 30) and only when a named tropical storm or hurricane has developed.

This public service is provided by the National Weather Service, NBC News, and USA Today. The hotline can be reached from anywhere in the U.S. by dialing 900-410-NOAA. The taped messages are continuously updated by the center as new developments occur.

The hotline can receive 7,200 calls simultaneously, or up to 216,000 calls per hour, 24 hours a day. Calls cost 50 cents for the first minute and 45 cents for each additional minute. Most calls cost 95 cents.

Last year more than 100,000 calls were made to the hotline when Hurricane Gilbert threatened the U.S. coast. In 1985, when the hurricane hotline was first established, as many as 700,000 calls were recorded during Hurricanes Gloria and Elena.

"The public can obtain the most updated hurricane information without any restrictions or delays while NHC meteorologists are heavily involved in forecast activity," said Elbert Friday, director of the National Weather Service.

Standard recordings identify coastal areas under hurricane watch or warning, storm position, wind speeds, anticipated path, and tidal effects.

Non-AT&T subscribers can reach the service by first dialing 1-0-288-900.

A hurricane hotline has also been established for the central North Pacific region , which includes Hawaii. The season also runs through November 30 and the hotline will be activated when a named tropical storm or hurricane develops in this region. This service is sponsored by the National Weather Service, AT&T, and KHON-TV of Honolulu for residents and inbound travelers from the mainland and Asia. The taped messages emanate from the NWS Central Pacific Hurricane Center and are updated as necessary. The hotline can be reached by dialing 1-900-410-WARN. Non-AT&T subscribers can reach the service by dialing 1-0-288-2900. The average call costs about 85 cents.

Hurricane Terms

Hurricane— A tropical cyclone or system of winds reaching constant speeds of 65 knots or more and rotating in a large spiral around a relatively calm center—the eye of the hurricane.

Tropical Storm— A tropical low pressure area with sustained wind speeds of 34 to 64 knots.

Tropical Depression— A tropical low pressure area with sustained wind speeds of 33 knots or less.

Tropical Disturbance— A moving area of thunderstorms in the tropics that maintains its identity 24 hours or longer.

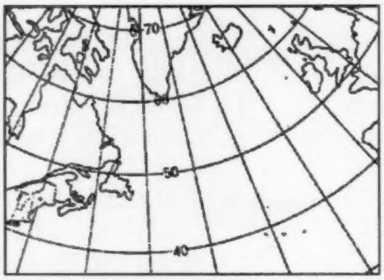
A Hurricane/Tropical Storm Watch is an announcement that hurricane or tropical storm conditions pose a threat to coastal areas within 36 hours.

A Hurricane/Tropical Storm Warning is issued for specific coastal areas where hurricane or tropical storm conditions are expected within 24 hours.

Hurricane Names for 1989

North Atlantic	Eastern North Pacific	Central North Pacific	Western North Pacific
Allison	Adolph	Akoni (ah–KOH–nee)	Winona
Barry	Barbara	Ema (EH–mah)	Andy
Chantal	Cosme	Hana (HAH–nah)	Brenda
Dean	Dalilia	Io (EE–oo)	Cecil
Erin	Erick	Keli (KEH–lee)	Dot
Felix	Flossie	Lala (LAH–lah)	Ellis
Gabrielle	Gil	Moke (MOH–keh)	Faye
Hugo	Henriette	Nele (NEH–leh)	Gordon
Iris	Ismael	Oka (OH–kah)	Hope
Jerry	Juliette	Peke (PEH–keh)	Irving
Karen	Kiko	Uleki (oo–LEH–kee)	Judy
Luis	Lorena	Wila (Vee–lah)	Ken
Marilyn	Manuel		Lola
Noel	Narda		Mac
Opal	Octave		Nancy
Pablo	Priscilla		Owen
Roxanne	Raymond		Peggy
Sebastien	Sonia		Roger
Tanya	Tico		Sarah
Van	Velma		Tip
Wendy	Winnie		Vera
	Xina		Wayne
	York		Abby
	Zelda		Ben
			Carmen
			Dom
			Ellen
			Forrest
			Georgia
			Herbert
			Ida
			Joe
			Kim
			Lex

The Western North Pacific list is a continuous one, picking up from the previous season. The Central North Pacific area runs from 140°W to 180°.



North Atlantic Weather Log January, February and March 1989

January – A normal climatic chart for this month shows a potent 1000-mb Icelandic Low centered just south of the Denmark St, with a 1020-mb Azores High south of the Azores. This month's chart was anything but normal. The Icelandic Low was in a normal position but with a 983-mb pressure. The high was centered over southern Europe at 1033 mb (fig 1). Anomalies ranged from -19mb in the Denmark St to +16 mb over Germany and Austria. The result was an extremely tight gradient over the northern shipping lanes, particularly between Iceland and the Norwegian Sea. A glance at the track chart indicates plenty of storm activity in the Denmark St and to the southwest, with a hole over Great Britain, Scandinavia and Europe.

At 700 mb the steering currents were oriented to reflect a strong cyclonic curvature Storms from the U.S. East Coast would tend to travel eastward gradually turning toward the northeast.

On This Date— January 28, 1922— The Knickerbocker snowstorm immobilized the city of Washington, DC. The storm produced 28 in of snow in 32 hr. The snow caused the roof of the Knickerbocker movie theatre to collapse, killing 96 people.

Extratropical Cyclones— From the 7th through 9th the upper Great Lakes suffered blizzard conditions as a storm that had developed over Kansas on the 5th moved northeastward and intensified. Gale force winds whipped snow and combined with arctic air to drop wind chill readings to -60°F. Up to 20 in of snow was measured in New York State, east of Lake Ontario.

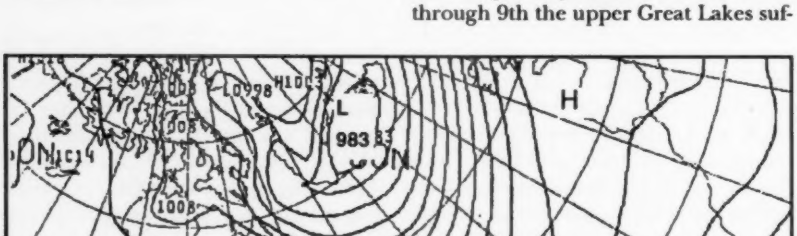


Figure 1.— The high over southern Europe was 1033 mb, which added to the strong gradient between Iceland and England.

❶ The month opened with a 965-mb remnant from December over Kap Farvel, Greenland continuing to terrorize the northern shipping lanes. However, another gem was brewing over North Carolina on the 3d. On the 3d the National Weather Summary mentioned that an old stationary front extended across the southeast part of the U.S. while westerlies curving around a Gulf of Mexico high were colliding with this boundary, producing scattered rain from Alabama into the Carolinas. The following morning a storm warning was in effect for strong winds in the North Carolina coastal waters with gale warnings extending from Maine to northern Florida. By 1200 on the 4th a 960-mb Low was raging near 37°N, 64°W (fig 2). Nearby the ***Stonewall Jackson*** battled 65-kn westerlies in 38-ft seas with a very steep slope. They also measured a 974-mb pressure. This report helped establish the potency of the storm. At 1800 another vessel near 41°N, 58°W reported a 961-mb pressure in 60-kn southerlies. To the south of the center vessels like the ***Sealand Performance, Sheldon Lykes, American Resolute*** and ***Gypsum King*** were hitting 45-to 60-kn winds in 12- to 25-seas. The system moved rapidly north northeastward as it intensified. By 1200 on the 5th the 943-mb center was over Newfoundland. In the Gulf of St Lawrence the VRKA was raked by 60-kn northerlies and measured a 968-mb pressure.

The system continued across

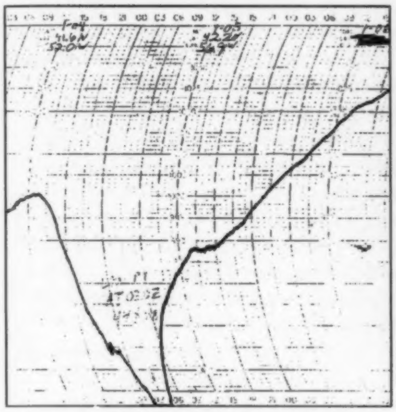


*Figure 2.— The **Nedlloyd Holland** recorded a 948-mb pressure at 0300 on the 5th.*

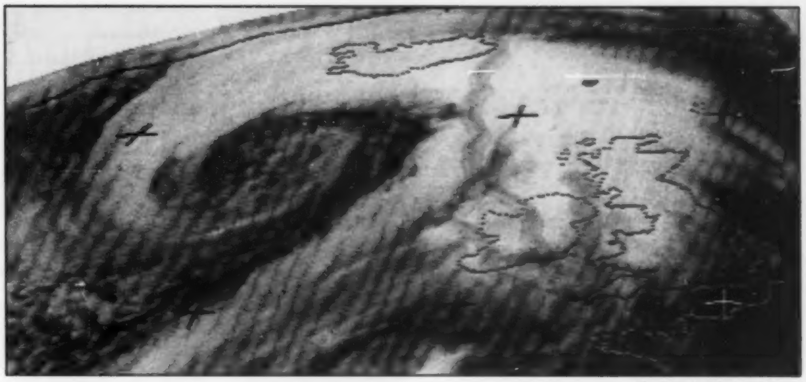


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Figure 3.— This 942-mb Low pressure system, south of Iceland, covers a large area at 0930 on the 13th in this IR satellite shot.

Newfoundland and stalled just west of Kap Farvel on the 6th. Pressure began to rise and the storm began to weaken. After 24 hr it headed toward the east but fizzled out south of Iceland by the 9th.

❷ This storm deepened as it moved across Quebec and Labrador. On the 9th its 964-mb center made it into the Labrador Sea and turned northward. Along its front a wave developed just southeast of Kap Farvel. By the 10th it had taken over as the dominant center with a frontal system that stretched into the Gulf of Mexico. Ships were reporting winds in the 45-to 50-kn range near the center and close to the northern section of the cold front. The ***Reykjafoss*** came in with several reports of winds near 45 kn. By 1200 on the 11th the center was in the Denmark St and pressure dipped to 951 mb. However the system filled quickly as it continued northeastward. Gales reached the Norwegian Sea as the frontal system continued eastward. This front also spawned the next big storm.

❸ On the 11th, near 38°N, 60°W a wave developed along the previously discussed front. It moved toward the northeast and slowly developed its own circulation. The gradient between this budding storm and a 1037-mb High to the southwest was tight enough to generate gale force winds, late on the 12th, in the seas between 30° and 50°W from about 35° to 50°N. However the following day the storm came into its own. Central pressure fell to 957 mb by 0600 as the storm crossed the 55th parallel near 25°W. At 1200 winds of 40 to 50 kn were being reported by such vessels as the ***Vesegonsk***, SPQQ, ***Catherine Schiaffino***, ***Viktoras Yatsenyavichus***, ***Fulgur*** and ***OSV C***. By 1200 on the 13th, the central pressure dipped to 942 mb (fig 3). The TFUD (62°N, 20°W) at 1500 reported a 948-mb pressure and this was confirmed by the TFHB, which measured a 954-mb pressure nearby. ***OSV L*** (57°N, 20°W) at the same time reported a 966-mb reading in 39-ft seas with a slope of about 1/20; winds were 55 kn. The frontal system was generating gales over the British Isles. Winds of 55 to 60 kn were reported between Scotland and Norway on the 14th as the center filled slightly to 956 mb. Reports were received from the TFLZ, TFUD, ***Ambarchik*** and the ***Nuka Ittuk***. The storm continued to fill as it drifted northward and was replaced by the next storm.

❹ This storm began in Montana on the 10th. It swung across James Bay on the 12th and moved off the Labrador coast the following day. At 1200 on the 13th a 980-mb center was located near 57°N, 55°W. Some 24-hr later it was a 955-mb Low heading toward the Denmark St. In combination with the previous storm it terrorized the northern shipping lanes on the 14th and 15th. The ***Canadian Explorer*** (50°N, 32°W) ran into 63-kn south southwesterlies at 1200 on the 14th while the ***Viktoras Yatsenyavichus*** was nailed by 45-kn winds, in 16-ft seas, about 600 mi southeast of the center. On the 15th the system swallowed the previous one and became dominant. However the following day it weakened rapidly as it headed for the Barents Sea.

❺ These two storms provided action over the western North Atlantic from about the 20th through the 23d. Both came to life on the 19th, one near Winnipeg and the other off New Jersey.

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Figure 4.— The center of this potent 952–mb Low was over Iceland at 1500 on the 27th in this IR photo.

The New Jersey storm intensified quickly and by 1200 on the 20th its central pressure was at 968 mb. Vessels were encountering winds in the 40–to 50–kn range. At 1800 the ***Jalisco*** (40°N, 43°W) ran into 48–kn west southwesterlies in 33–ft seas.

Meanwhile the Winnipeg storm was moving across Lake Erie. It continued to intensify as it swung east northeastward. By 1200, on the 21st, central pressure hit 970 mb and 24 hr later it was at 966 mb, northeast of Newfoundland. By this time the New Jersey system had begun to fill as it approached Iceland. On the 21st winds ranged from 40 to 60 kn and seas were running 15 to 25 ft along the northern shipping lanes as both circulations dominated. On the 22d the Winnipeg storm took control, although two centers were apparent for the next several days.

⓫ While this system doesn't appear on the track chart it evolved out of a complex mess over the Denmark St. For several days, beginning on the 24th, a Low remained stationary west of Iceland; actually the two previous systems had some imput into this situation. Anyway several centers were analyzed at various times during the period from the 24th to the 26th. Finally at 1200 on the 27th a 952–mb Low was centered over Iceland (fig 4). The pressure gradient was intense between Iceland and the British Isles thanks, in part, to a large 1043–mb High over eastern Europe. For example at 1200 the ***Vigilant*** (58°N, 06°W) ran into 60–kn southerlies while a short distance away the ***Claymore*** was battling 26–ft seas and 33–ft swells in 52–kn winds. At 1800 the ***Hankar*** near 64°N, 11°W reported a 956–mb pressure in 60–kn south southwesterlies. At 0600 on the 28th the analysis indicated a 944–mb pressure center just north of 70°N near 5°W. While the system was moving out of harm's way it was still generating 50– to 60–kn winds over the waters north of about 60°N and east of about 15°W.

Tropical Cyclones— The last North Atlantic tropical cyclone to develop in January occurred in 1978. That was an unnamed subtropical system, which developed on the 18th near 22°N, 41°W and dissipated north of Puerto Rico on the 22d.

U.S. Air Force

Figure 5.— The HH53C U.S. Air Force helicopter is more commonly known as the Jolly Green Giant.

Casualties— On the 15th, U.S. Air Force helicopters rescued 32 crewmen from a stricken cargo ship in an Atlantic storm after a 6–hr dash from eastern England— refueling twice in midair. The Filipino crew of the Cypriot–registered ***Yarrawonga***, the West German captain and his wife were winched to safety by two U.S. HH53C Jolly Green Giant helicopters (fig 5) about 300 mi west of Iceland.

On the 28th the stern trawler ***Kerry Kathleen*** grounded on the north side of Fair Isle (59.5°N, 01.6°W) with nine people on board. Winds were southerwesterly at 35 to 45 kn and the vessel was holed but she managed to proceed to Lerwick under escort.

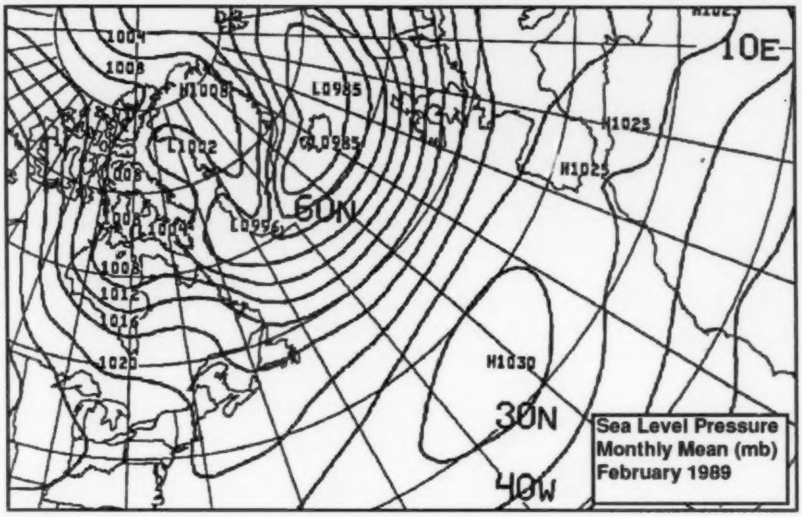

Figure 6.—An intense 985–mb Icelandic Low was one of the many climatic features in both the Atlantic and Pacific that were stronger than normal in February 1989.

February— This was a month of extremes in the Northern Hemisphere. The Western Pacific experienced an intense climatic high, which created anomalies of up to +27 mb in the northeastern waters. In the Atlantic a large 985–mb Icelandic Low resulted in anomalies up to –23 mb northeast of Iceland. In addition the Azores High was 10 mb stronger than normal (fig 6). The result was a tight pressure gradient over the northern shipping lanes. The steering pattern at 700 mb was oriented from the west southwest to the east northeast. In an ideal situation a storm over New York would end up near London.

On This Date— February 23, 1802 — A great snowstorm raged along the coast of New England. Snowfall totals reached 48 in north of Boston and three large ships were wrecked along Cape Cod.

Extratropical Cyclones — While a look at the storm track chart indicates that there wasn't a large number of storms, the activity was concentrated around Iceland and a typical path from off the mid Atlantic U.S. coast to Iceland could be drawn.

❶ ❷ The month opened with a double bang. Storm No. 1 actually came to life at the end of January over Quebec, but didn't get it fired up until this month. The track chart picked it up over Newfoundland on the 1st as a 984–mb Low. Several hours later storm No. 2 showed up as a 972–mb center off northern Labrador. The first system moved rapidly northeastward and by 1200 its central pressure was down to 960 mb about 180 mi southeast of Kap Farvel. The ***Viktor Bugayev*** and ***OSV C*** (53°N, 36°W), in the same area, reported winds in the 45–to 50–kn range and seas of 31 ft. At 1800 the ***Atlantic Companion*** (48°N, 35°W) ran into 30–ft seas whipped by 50–kn winds. By this time the 956–mb center was crossing the 60th parallel near 35°W. A number of vessels ran into winds of 45 to 50 kn at 0000 on the 2d east of the center. These ships included ***OSV L, Vesturland, Disarfell, Professor Molchanov*** and the ***Baffin***.

Storm No. 2 was intensifying as it headed northward and then swept southeastward over Kap Farvel on the 3d. By 0000 on the 3d, it was becoming the dominant circulation as the first storm moved into the northern Norweigian Sea. The ***Dovend*** at 0600 (65°N, 32°W) right near the storm's center, reported a 964–mb pressure with 54–kn northerlies. By 1200 the storm's central pressure was down to 952 mb as it headed into the Denmark St. This intensity was picked up by a number of vessels. ***OSV L*** (57°N, 20°W) reported a 58–kn west southwesterly in 20–ft swells while the ***Ocean Prawns*** (66°N, 31°W), with a 960–mb pressure, ran into 60–kn northeasterlies. The ***Baffin***, some 450 mi to the northeast of the center, came in with a 55–kn east northeast wind. The system maintained its intensity into the 4th as it moved across to Norwegian Sea. During this period outstanding reports were received from many vessels including ***OSV L, Vigilant, Iolair, Norna, Vesturland, Soelvi Bjarnason, Nordic Link, Arni Fridriksson, Pioneer Severod–Vinska*** and the ***Valdivia***. The reports indicated that winds, in general, were hitting 40 to 50 kn while seas were in the 10–to 20–ft range. The system remained potent into the 5th as it headed toward the Barents Sea.

❸ While storm No. 2 was barreling into the Norwegian Sea on the 4th, this storm was taking shape just south of Nova Scotia. Its path was northeastward like most of the storms this month. By 1200 on the 5th it was the dominant circulation over the northern shipping lanes as its central pressure was estimated at 964 mb. In combination with the previous storm, gale and storm force winds were being generated in the North and Norwegian Seas. At 0600, on the 5th, the ***Iolair*** (58°N, 01°E) ran into 58–kn westerlies in 16–ft swells. Winds of 50 kn or more were reported by ***Seagair, Maersk Dispatcher, Nebhana, Jens Kofoed*** and the ***Konstantine Olchanskii***. The ***Seagair*** had swells of 26 ft. By 1200 on the 6th, the system was over Iceland and heading northward. The strongest winds and tightest gradients were southeast of the center, where the storm was interacting with a 1040–mb High over Europe. Gales were blowing as far south as Scotland. The storm broke down into a multi–centered sys-

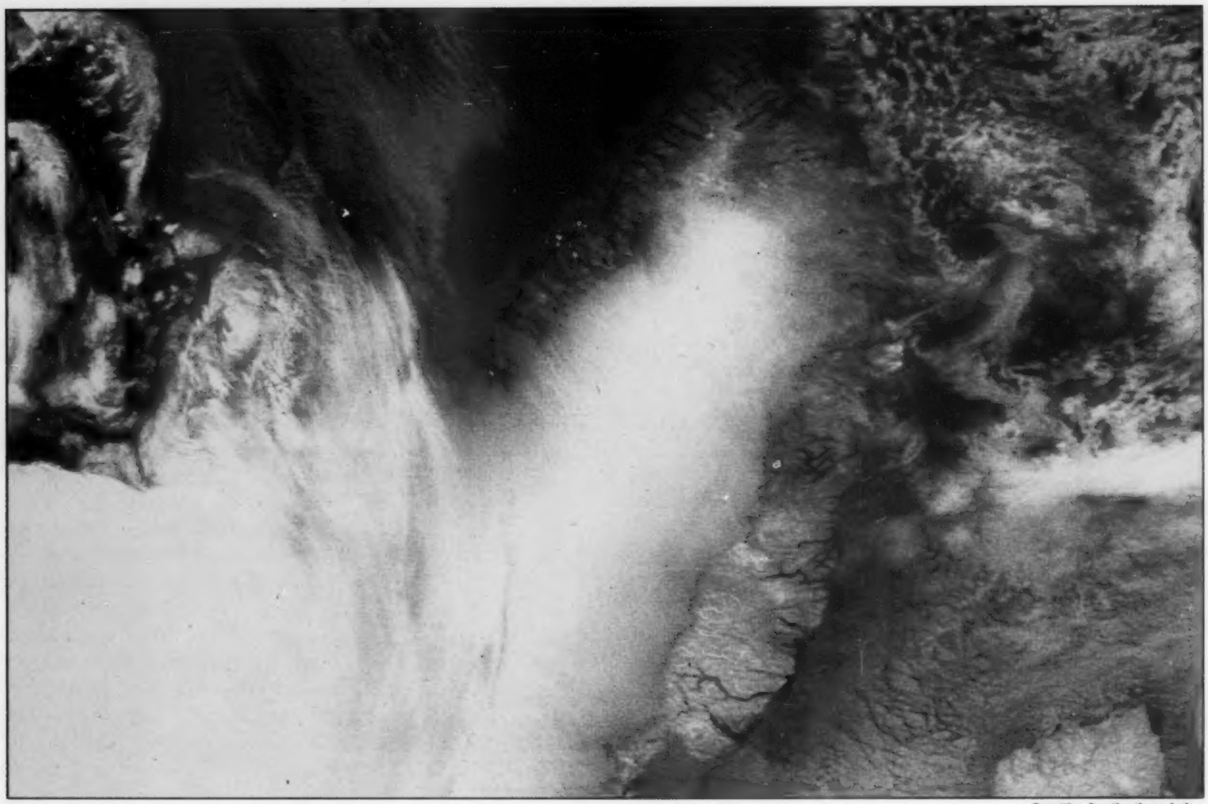

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Figure 7.— This potent storm is caught entering the Denmark St late on the 9th of February. In addition to the cloud pattern, snow and ice cover can also be seen.

tem on the 6th and 7th but the gradient remained strong over the North Sea through the 7th.

❹ Along the front that extended from the previous storm, this system popped up near 45°N, 35°W on the 7th. Moving northwestward it intensified into a 978–mb storm near 53°N, 26°W, by 1200 on the 8th. Roughest conditions were being experienced south and southeast of the center, out to about 600 mi. The ***Atlantic Compass*** (49°N, 24°W) encountered 52–kn westerlies in 26–ft seas that had a slope of 1/20—not too steep. A good long northwesterly fetch on the 8th helped generate 26–ft seas as well to the southwest of the storm center. During the 12 hr from 1200 on the 8th to 0000 on the 9th the system wound into a 950–mb storm near 60°N, 25°W. ***OSV L***, within 100 mi southeast of the center, gave us a good look at the storm's characteristics. They measured 50 to 52 kn southerlies, a 962–mb pressure and estimated seas up to 26 ft, between 0000 and 0100 on the 9th. In another direction the ***Valur***, 300 mi to the northeast, encountered 52–kn east southeasterlies with a 988–mb pressure at 0000; on the 0300 observation 52–kn winds remained and pressure dropped to 981 mb. ***OSV L*** had a 959–mb reading at 0400, and by 0600 their winds had climbed to 57 kn. Central pressure at this time was estimated at 947 mb. On the 9th (fig 7) the storm began to turn northward. It moved across Iceland and into the Denmark St. The following day after a southwestward trek, it headed northward along the east Greenland coast. It remained potent into the 13th. At 1200 and on the 11th the ***Jokulfell***, in the Denmark St just south of the center, battled 62–kn southwest winds.

❺ This storm is mentioned only because its infusion with another system in the Norwegian Sea on the 15th produced a large severe storm that affected the whole eastern North Atlantic region for several days. On

the 14th this 976–mb Low was heading toward oblivion north of Scotland. However it merged with a previous Low that had stalled in the northern Norwegian Sea. The two combined into a potent circulation whose central pressure was estimated at 942 mb by 1200 on the 15th. How potent was it? At 1200 no less than 20 vessels radioed in with winds of 40 kn or more; the C7M (66°N, 02°E) carried a 959–mb pressure while the LFAW (64°N, 07°E) was raked by 56–kn winds in 30–ft seas. At 1800 the ***Karl Liebknecht*** (66°N, 08°E) was blasted by a 74–kn west northwesterly and recorded a 952–mb reading in 30–ft seas. Conditions were horrendous. Winds of 40 to 50 kn extended into the 16th but the violence was diminishing noticeably, mainly because the storm was moving into the Barents Sea.

Ⓑ Monsters of the Month— The month closed with a messy situation over the eastern North Atlantic. It began when an innocuous looking Low popped up on the 19th near 40°N, 55°W. By the 21st it was heading northeastward between Iceland and the British Isles. However on the 22d it deepened and became the strongest of three centers in a complex low pressure system that sprawled over much of the northern North Atlantic. By the 23d pressure had dropped to 964 mb at 1800 near 62°N, 05°W. Meanwhile another Low was intensifying to the south. To complicate matters even further, a large 1042–mb High had decided to center itself near 35°N, 35°W. The gradient between the High and the Lows was creating problems for shipping in the eastern ocean, particularly between 40° and 55°N. The ***Atlantic Conveyer*** near 43°N, 22°W, at 0000 on the 24th, ran into a 50–kn wind in 16–ft swells. Winds of 40 to 45 kn were common as were swells of 15 to 20 ft. For a time nothing would give so the region was in a vise between the two systems. There was a report from the ***Ravenscraig*** at 0000 on the 25th of swells up to 33 ft. The fetch eventually stretched from Greenland to Gibraltar. The two Lows, one over England and the other over the southern North Sea intensified to 955 mb and 952 mb respectively, early on the 26th. The combined circulation covered the eastern North Atlantic. The ***Asifi*** (40°N, 13°W) weathered 60–kn northwesterlies in 30–ft seas and 43–ft swells. The High had shrunk to 1032 mb by this time but the Lows had grown into an out–of– control monster. On the 27th there was one 962–mb center in the North Sea and a 964–mb center in the Norwegian Sea; the High had built back up to 1035 mb. The following day a single 959–mb center was analyzed near 60°N and the Greenwich Meridian. Finally on the 29th a large 1050–mb High built in and forced the Low eastward causing it to fill.

Tropical Cyclones— The last recorded February tropical cyclone in the North Atlantic occurred in 1952. While no hurricane or tropical storms developed this year, a tropical disturbance occurred. This area of disturbed weather, associated with a trough of low pressure, brought gusty winds and heavy showers to the islands of the northeast Caribbean on the 15th.

At the same time another disturbance in the form of a low pressure trough developed off the northwest coast of Africa. This low pressure trough didn't really develop into much nor did it hang around very long. However it generated rainstorms that swept the Canary Is on the 16th. These were the heaviest storms to hit the island this century and resulted in mudslides around Las Palmas. To make matters worse the storm came after hot sirocco winds, blowing sand from the Sahara Desert, choked plants and damaged crops the week before.

Casualties— On the 17th the ***Armana*** was taking on water and sinking, in the North Sea, northeast of Inverness, Scotland. Winds were southerly force 9 with 12–ft seas. Fourteen people were onboard. A rescue mission resulted in the vessel being towed to port. On the 19th the ***Tawaki*** lost six containers overboard in rough weather in the North Sea. The ***Alexandros*** grounded in heavy weather in the North Sea on the 14th.

The Monsters of the Month (No.6) wreaked havoc both on land and sea, from Scotland to Algeria. While most of the problems occurred on the 25th through 27th, they began on the 22d when the Panamanian–registered cargo ship ***Secil Angola*** sank 350 mi west of Scotland. Rescue teams from the RAF and U.S. Air Force were unable to locate the South Korean crew of 17, who apparently had abandoned ship in the heavy seas. Five bodies were recovered and seven more sighted at last report. On the 24th the ***Waltraud*** overturned off Portugal but the crew was lifted off by helicopter. The following day an SOS was received from the ***Anna Leonhardt***, in the Bay of Biscay, requiring immediate assistance due to bad weather. The ***Tolaga Bay*** responded and sighted lifejacket and liferafts without people; 15 people were missing. On the night of the 26th the 16,239–ton ***River Gurara*** also sank in the Bay of Biscay after being blown onto the rocks of Portugal's Cape Espichel, some 20 miles from Lisbon. At least 5 people died and 14 were missing. Also the Spanish Trawler ***Nuevo Paloma de la Paz*** sank in the Bay, but the 13 crewmen were rescued after abandoning ship in reported 50–ft waves. A seaman was listed as missing after being swept off a fishing vessel in heavy weather off the coast of Asturias.

On the 27th ships and planes searched Spain's southern coast for survivors who were lost in the heavy weather affecting the region. The search began for crews, totaling 30 people, from the fishing vessels ***El Amirante*** and ***Chorillo*** began after winds subsided a little; they were last heard from late on the 26th. On land, Spain suffered at least 16 deaths with dozens

unaccounted for. There were many other incidents involving grounding, heavy weather damage and cargo shifts during this hectic period. In Istanbul, on the 27th, heavy winds in southwest weather caused the Mv ***Uskudarli I*** to sink near Zeytin Burna; the crew was rescued.

On the 13th and 14th strong winds, associated with a Low and front, raked Scotland, the north of England and Northern Ireland. Gusts to 78 kn occurred in Northern Ireland while they reached 86 kn at Malin Head meteorological station. Strong winds brought down trees, overturned lorries and disrupted ferry services. Automobiles were blown off roads and a small plane was flipped on its back. The ***Tor Gothia*** ran aground on the 14th, 20 miles from Cromer; it was refloated the following day. The bulk carrier ***Fermita***, with 19 people aboard, had to anchor in Stornoway Bay after making no heading at full power. Off the Donegal coast in Ireland the ***Osaka*** grounded in heavy seas but was eventually able to refloat with some assistance. At a fish farm on the Cromarty Firth, north of Inverness eight steel cages broke loose, in the storm, freeing 40,000 rainbow trout, which were ready for market.

A local Mediterranean storm on the 15th was responsible for another tragedy. In winds estimated at about 50 kn the ***Maassluis*** broke away from its mooring at Skikda, Algeria and ran onto the breakwater. According to reports the vessel broke its back and sank in shallow water. Bad weather hampered rescue attempts; just 2 crewmen were rescued with 27 others missing.

March— Two striking features mark this months climatic chart—a summertime Bermuda–Azores High and a wintertime Icelandic Low (fig 8). However, the high was higher than any normal summer month while the low was lower than any winter month. If it's true that spring is a battle for control, this was a war. The result was negative anomalies up to 20 mb over Iceland and 10–mb positive anomalies in the mid North Atlantic. The 700–mb steering currents were neatly arranged in a gradual cyclonic curvature across the North Atlantic. In an ideal pattern like this a New York storm would arrive over northern Portugal.

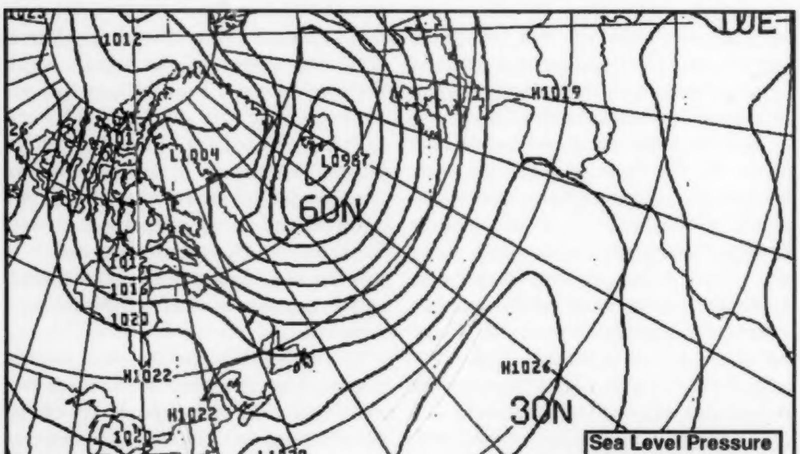


Figure 8.— Both major pressure systems—the Icelandic Low and the Azores–Bermuda High— were much more intense than normal in March.

On This Date—March 7, 1717—This day marked the end of the great snow. A composite of four storms hit the eastern United States over a 9–day span. After the fourth storm snow depths averaged 60 in.

Extratropical Cyclones— There was plenty of action along the northern shipping lanes this month as storms tended to concentrate north of 45°N.

❶ This system started as one of several waves along a front that stretched from Labrador to southern Mexico on the 5th. It formed near Quebec City. By 1800 on the 6th it was a 966–mb Low in the North Atlantic east of Labrador. Then it went wild. Pressure plummeted to 948 mb by 1200 on the 7th and was estimated at 936 mb by 0600 on the 8th. The system covered a major portion of the northern North Atlantic.

At 0600 on the 7th ***OSV C*** (53°N, 16°W) reported a 968–mb pressure with west southwest winds of 48 kn in 26–ft seas. On the 7th winds were running from 40 to 50 kn southeast and south of the center. At 1200 on the 8th the ***Baffin***, about 450 mi southwest of the 940–mb center, and the ***Klippergracht***, the same distance to the southeast, both ran into 55–kn winds with a pressure near 988 mb. The ***Baffin*** also reported 33–ft swells. By 1800 the ***Klippergracht's*** winds were up to 58 kn. The highest seas were being encountered by the ***Naja Ittuk*** (60°N, 24°W) at about 50 ft. The storm remained potent for several days. As it approached the Denmark St it turned a counterclockwise loop and started a second one before fizzling out on the 13th.

❷ This storm developed as a secondary center, off the southeast coast of Greenland, on the 17th. The following day it inherited the circulation of the previous storm and infused it with new life. It had help from another system and, by the 20th, a 956–mb center was analyzed near Iceland. Shipping was already feeling the sting of this complex system at 1200 on the 19th. Winds of 50 to 70 kn were being

Wide World

Figure 9.— As a rescue helicopter hovers overhead, high seas pound the wreck of the Panamanian–registered cargo ship ***Secil Japan****, against the rocks in Hell's Mouth, a bay near St Ives, Cornwell, southwest England, early on the 13th. The 2500–ton vessel, listing 20° to starboard, was driven by high winds onto the rocky coastline on the night of the 12th. Of the 16–man Korean and Filipino crew, 15 were rescued.*

encountered by such vessels as the ***Ocean Australia, Pacific Sandpiper, Petrodvorets, Daynava, Birshtonas, Ostrov Mednyy*** and ***OSV L***. These reports were from about 100 to 600 mi south of the center. Seas at the time were running at 13 to 28 ft while swells were estimated at up to 33 ft. The storm continued to intensify until 0600 on the 20th. The lowest pressure recorded by ship was a 959–mb reading at 1800 on the 19th by the ***Petrodvorets*** (54°N, 18°W) in 52–kn westerlies. The storm remained potent for several more days.

❸ On the 20th this system was a weak frontal wave over Texas. It travelled along the front and by the 21st, at 1200, was a 1006–mb Low over southeastern Maine. The following day it developed an identifiable circulation as it turned toward the east northeast. However it was on the 23d that this system really exploded. By 1200 it was a 966–mb Low near 58°N, 25°W. Winds in the 45– to 50–kn range were common from Greenland to the North Sea and south to 50°N. Vessels reporting in included ***OSV C, CMB Europe, Frithjof, Nukka Ittuk***, and the ***Atlantic Carrier***. The storm remained potent as it crossed the Greenwich Meridian on the 24th near 61°N. Seas in general ran 15 to 25 ft. At 0000 on the 24th ***OSV L*** (57°N, 20°W) reported 50–kn westerlies in 23–ft seas and 28–ft swells. The Atlantic Amity (58°N, 09°W), at this time, reported 50–kn westerlies, a 974–mb pressure and 16–ft swells. The North Sea was swarming with reports of gale and storm force winds throughout the 24th. Conditions eased somewhat the following day.

❹ The month ended with a bang. A storm travelling at speeds up to 50 kn steamed out of South Dakota on the 27th, across the Great Lakes on the 28th and off Newfoundland the following day. Even at this stage it looked like just an average 984–mb Low moving quickly towards oblivion. However, it was determined to have its place in the sun. By 0000 on the 30th its central pressure had plummeted to 968 mb; 12 hr later it was down to 952 mb. This did not go unnoticed by ships in the area. At 0600 the ever–vigilant ***OSV C*** (53°N, 36°W) responded with a 48–kn southerly, a 977–mb reading and 26–ft seas. As far south as 45°N (46°W) the ***K Donelaytis*** picked up 50–kn west northwesterlies. In general winds ran 40 to 50 kn as the storm turned north northeastward toward the Denmark St. At 0000 on the 31st the ***Maersk Terrier*** (62°N, 50°W), with a 969–mb pressure, encountered 52–kn west northwesterlies. As rapidly as it intensified the system degenerated on the 1st of April.

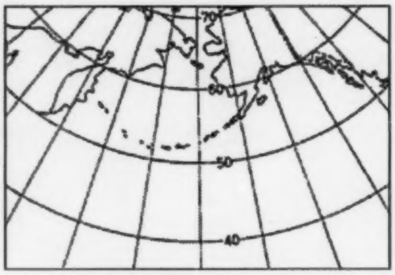
Tropical Cyclones— The last March tropical cyclone in the North Atlantic occurred in 1908. It attained hurricane strength as it move south southwestward from the tropical Atlantic through the West Indies, east of Puerto Rico, and into the Caribbean Sea.

Casualties— Early in the month drifting wood and lifeboats were sighted off northern Spain, close to where the bulk carrier ***Kronos*** is believed to have disappeared in the late February storm. The 392–ton vessel had a crew of 20. On the 7th a search was begun for the fishing vessel ***Tijl Uilenspiegel***. The 143–ton ship sank in the Irish Sea with a 5–man crew.

The ***Secil Japan*** foundered in bad weather off the southwest coast of England on the 13th (fig 9). The 2500–ton, Panamanian–registered cargo vessel was driven by high winds against the rocks in Hell's Mouth, a bay near St. Ives Cornwall. Of the 16 crewmen, 15 were rescued. Missing was believed to be the 3d mate who lost hold of a safety line as he drew level with the doors of the rescue helicopter and fell 200 ft into the sea. Her sistership, the Secil Angola, sank last month off the Scottish coast and all 17 crewmen were lost.

January— The big weather news this month in the North Pacific was the frigid weather that gripped Alaska and the Bering Sea. It created numerous problems and resulted in several marine fatalities (see February summary). The Aleutian Low had it usual January double center, only this month the one in the Gulf of Alaska was 10 mb deeper than normal (fig 1). In addition the subtropical high was more reminiscent of summer than winter. The 1030-mb pressure was 13 mb stronger than normal. At the 700-mb steering level the flow was influenced by this subtropical high. The normal pattern is a gentle cyclonic curvature around an upper Low in the Sea of Okhotsk. This month the strong subtropical ridge altered the pattern in the eastern North Pacific tightening the gradient and forcing storms farther north.

On This Date— January 30, 1983— A series of Pacific Coast storms finally came to an end. The storms, attributed in part to the ocean current *El Niño,* produced swells 15 to 20 ft high, which ravaged the beaches of Southern California.



North Pacific Weather Log January, February and March 1989

Extratropical Cyclones— The Aleutian Low is a climatological composite of the storms that move across the Pacific in a particular month. It can be made up of a few strong systems or a large number of weak to moderate storms. This month it appears to have been the latter, with activity concentrated in the Gulf of Alaska region. Even though there weren't many major systems, the strength of the subtropical high to the south helped create tight pressure gradients, which led to increased winds speeds and also long fetches that helped build up seas.

The Weather Logs, cyclone tracks, buoy, gales and wave tables and mean pressure charts provide a definitive report on the primary storms that affect the North Atlantic and North Pacific Oceans. The Monster of the Month is a title given to an extratropical storm that has been particularly hazardous to shipping. All storms can be dangerous. The tropical cyclones summaries are based on reports from, the National Hurricane Center, Royal Observatory at Hong Kong and the Joint Typhoon Warning Center at Guam. They are detailed but should be considered preliminary until the final reports are issued. Unless otherwise stated, winds are sustained and time is Universal (UTC). The number next to the extratropical summary corresponds to the same number on the track chart.

❶ On the 1st a center developed near Hokkaido, Japan. It swung east southeastward and intensified. By the 3d at 1200, the central pressure had dropped to 970 mb as the storm headed northeastward and then sharply northward. At 1800 the ***Emerald Coast*** (52°N, 179°E) picked up a 986-mb pressure in 49-kn southeasterlies; this was confirmed by the ***Osprey Arrow***, nearby, which had run into a 48-kn wind. As the storm headed into the Bering Sea its pressure plummeted to 956 mb by 1200 on the 4th (fig 2). Vessels in the northern shipping lanes were experiencing 40-to 50-kn winds in 10-to 20-ft seas. Fortunately the storm moved quickly out of harm's way as it crossed into eastern Siberia on the 5th.

❷ This storm came to life on the 16th as a wave along a cold front, near 33°N, 153°E. It organized slowly as it headed east northeastward. It was forced northward by a large 1035-mb High centered near 35°N, 135°W. It wasn't until the 18th that ships began to take

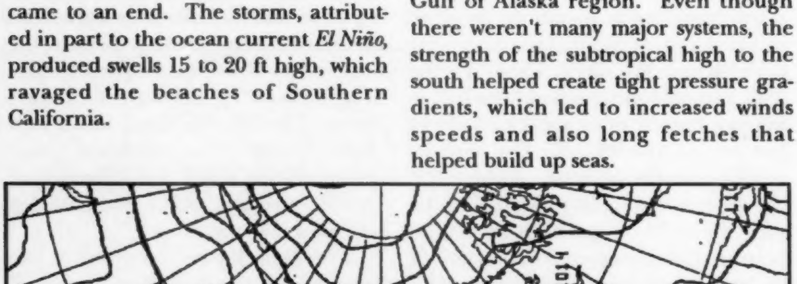
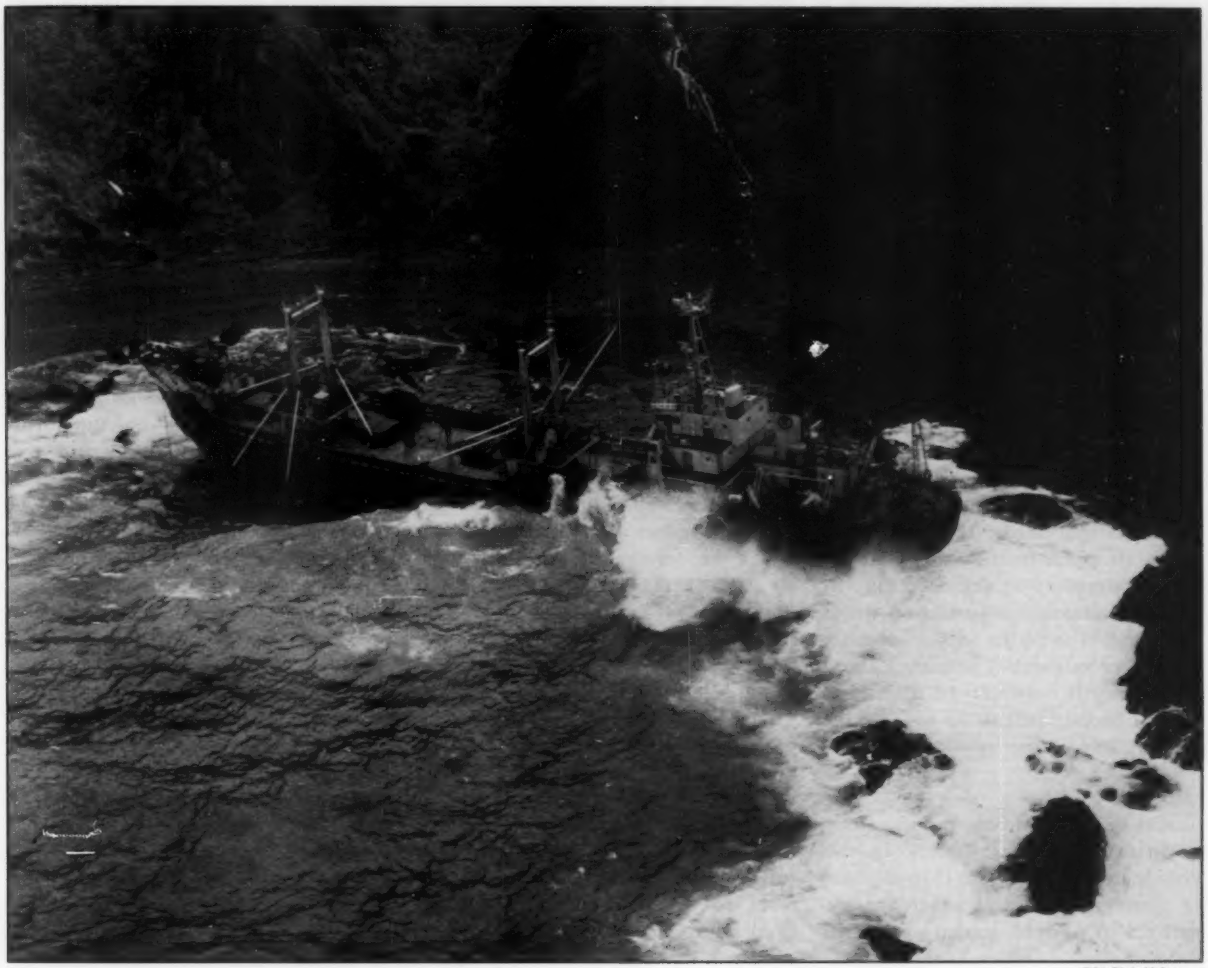


Figure 1.— The main features for January include a deeper-than-normal Aleutian Low center in the Gulf of Alaska and a strong subtropical high.



PA2 Chris Haley

Figure 2.— The 285–ft Chil Bo San grounded after being driven onto jagged rocks by strong winds and raging 20–ft seas off the Aleutians on the 11th of January.

notice of this system. The ***National Pride,*** 150 mi southwest of the center at 0000, encountered 40–kn westerlies in 15–ft seas. At this time the circulation was still relatively small but the storm continued to intensify. By 1200 on the 19th the 970–mb center had crossed the 50th parallel near 150°W. By 1800 several vessels were reporting winds of 40 kn or more including the ***Regina Maersk, Nosac Skaukar, Hyundai Pioneer*** and the ***Sealand Kodiak.*** On the 20th some storm force winds were reported and seas south of the center were running 15 to 25 ft. At 0000 the ***Cornucopia*** (51°N, 139°W) indicated she was battling 66–kn northerlies in 36–ft swells. Six hr later the ***Alligator Pride*** was nailed by 52–kn west southwest winds in 26–ft swells, some 120 mi south of the center. The ***Cornucopia's*** winds, at this time, had dropped to 48 kn but she was fighting 39–ft swells. The storm finally began to weaken as it moved ashore later in the day.

❽ South of Tokyo on the 23d, this storm began showing signs of organization. Moving east northeastward then northeastward it intensified. Early on the 25th it crossed the 45th parallel, near 160°W, and central pressure was down to 968 mb. At 0600 the ***Osprey Arrow*** sent in an excellent report near the center. She recorded a 967–mb pressure in 42–kn northerlies with swells of 23 ft. Corroborating reports were received by the ***Alligator Pride*** and the ***Century Leader No. 1.*** By 1200 the central pressure had dipped to 964 mb and the ***Osprey Arrow*** hit 50–kn winds although her pressure was up to 975 mb. At this time the system began to move toward the east southeast and then southwest. A look at the track chart shows what an unusual movement this was. However, the large subtropical high had split and weakened

slightly about this time, providing a temporary gap. In addition a large High was building over the Bering Sea and Alaska, which helped force this storm southward. This large High was an indication of the severe cold that was dominating the northern regions.

However the storm continued to affect ships in the region. At 0000 on the 26th storm force winds were reported by the ***Van Trader, Osprey Arrow, Shoryu Maru*** and the ***California Mercury***. Swells were in the 20–to 26–ft range. These conditions continued into the 27th as the storm turned southeastward. It began to weaken on the 28th.

Tropical Cyclones— The first tropical cyclone of the year reached tropical storm strength on the 18th near 17°N, 154°E. It was named Winona and was moving westward at about 25 kn. By the 19th maximum sustained winds had climbed to 55 kn with gusts to 70 kn. Later in the day it moved about 260 mi north northwest of Ulithi, but winds had dropped to 45 kn. By the 20th it was a disspipating tropical depression.

Casualties— Early in the month another inter–island ferry sank in the Philippines leaving more than 60 dead or missing. The ***Jem II***, which was carrying 196 people, mainly students returning to school after the holidays, capsized in choppy waters of Tablas Is. The ship capsized after passengers, panicked by huge waves, all ran to one side of the vessel.

Toward the end of the month monsoon rains, from a tropical depression and a cold front, battered the central Philippines leaving at least 60 dead in floods and landslides. Some 200,000 people were sheltered in evacuation centers.

The ***Chil Bo San*** was driven aground on the 11th (fig 2). See the February summary for an account of more havoc wrought by the frigid weather over Alaska.

February—The dominant feature was a large, intense high centered over the Yukon and covering the eastern North Pacific (see insert pg 53). The Aleutian Low (fig 3) was pushed northwestward of its usual location and was a little more intense than normal. This resulted in negative anomalies up to 15 mb. The steering pattern in the upper atmosphere was transformed into an omega shape with a trough centered over Kamchatka and a ridge centered in the Gulf of Alaska. If a storm followed this pattern it would move from Tokyo eastward to the dateline then swing sharply north northeastward across the Alaskan Peninsula to near the Arctic Circle. Then it would plunge southward and move across Vancouver Is before moving eastward again over Oregon.

On This Date— February 18, 1899 — The temperature at San Francisco soared to 80°F, a February record for the city. At the same time much of the central U.S. was just beginning to recover from the most severe cold wave in the Nation's history.

Extratropical Cyclones— A look at the track chart for February shows a real lack of cyclonic activity over the northeast North Pacific. The hot spot was east of Kamchatka in the Bering Sea.

❶ Toward the end of January a stationary front stretched from the Kamchatka Peninsula southwestward. On the lst of February a low pressure center developed off the east coast of Kamchatka, while a wave was organizing to the south. They merged and one circulation formed on the 2d, as central pressure quickly dipped to 972 mb. The system was turning northwestward back toward the Kamchatka Peninsula. The overall circulation, combined with the enormous High over the Yukon, was generating storm force winds throughout the northeast North Pacific. For example at 1800 the ***Valentina*** (54°N, 164°W) was nailed by 70–kn east southeasterlies, the ***Poutivl*** (52°N, 153°W) reported 62–kn east southeasterlies and the ***Century Leader No. 1*** caught a 55–kn southeast wind in 33–ft swells. Central pressure dipped to 960 mb early on the 3d. The gradient over the eastern Bering Sea and southeast of the Alaskan Peninsula was intense. Winds of 50 to 60 kn were common and some swells were reaching 40 ft. Things lightened up a little on the 4th as the storm weakened near land. However the following day it reintensified as it moved southeastward through the Bering Sea. The storm merged into a system from the south and pressure was down to 964 mb at 0000 on the 5th. Storm force winds were being registered by such vessels as

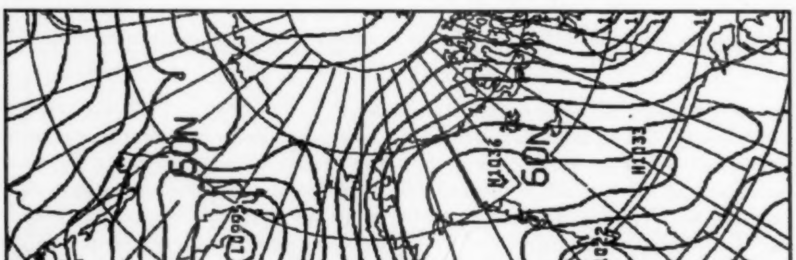


Figure 3.— Seeing is believing, so take a good look at the high over Alaska, because it's unlikely to occur again for quite some time. It was responsible for the severe cold that gripped the region.

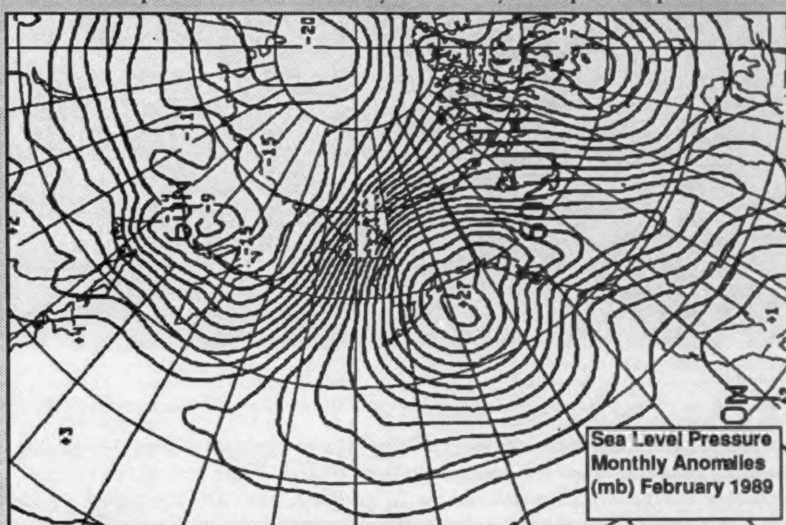
The Alaskan High

When you look at the mean sea level pressure chart you may have to look twice (fig 3). High pressure in the Gulf of Alaska in February? Somebody goofed. Just to reassure you, we are including the sea level pressure anomaly chart. Remember the frigid weather they suffered through in Alaska this past winter. Here it is in terms of pressure. As dramatic as these averages are they only begin to tell the story. For example on the 2d of February in the eastern part of Canada's Yukon territory, a high pressure center of 1076 mb was analyzed. On January 31st at Northway in eastern Alaska a 1078.23–mb reading was made. This was the strongest high pressure system ever recorded in North America. Air travel was suspended because altitude determination is based upon barometric pressure and most equipment is not calibrated for readings above 1049 mb. Readings were exceeding 1055 mb in a wide area.

Of course the pressure was only part of the story. It was the cold that caused the real problems. Temperatures in Alaska toward the end of January and beginning of February fell to more than –70°F. An unofficial reading of –86°F was received from near McGrath, AK on the 28th of January. Fairbanks recorded a –60°F reading on the 30th while Nenana had a –61°F temperature. This weather was the culmination of a colder than normal period that had covered Alaska and the Bering Sea since mid December.

The effect of the frigid weather was calamitous to shipping. It was estimated that 15 fishing vessels were lost in the Bering Sea during one of the worst winters in living memory. Winds exceeding 100 kn were estimated in northern waters at times. Icing was prevalent (fig 4). The Vestfjord a crab–fishing vessel, with 5 crewmen and one passenger, went down in stormy seas off Kodiak Is on January 28th. It is believed that the superstructure icing was so heavy that the vessel could not cope with the high winds and 30–ft seas. In December three fishermen were reported to have survived 48 hr in freezing waters off the Aleutians after the trawler ***Arctic II*** capsized and sank in heavy seas. They were picked up in a liferaft. Lifeboats, sent from a Korean vessel, and a Coast Guard helicopter rescued 54 crewmen from the refrigerated fish carrier ***Chil 30 San No. 6*** which ran aground on Unalaska Is in a blizzard on the 11th of January. The tug/supply vessel ***Amalaska I*** reported heavy weather damage on the same day.

The Alaska State Trooper patrol boat ***Vigilant*** braved high winds and icing to deliver an emergency shipment of fuel to Port Lions on Kodiak Is. In winter military exercises 37 soldiers suffered frostbite. Cold wind and ice made it difficult for large cargo vessels to get in and out of Anchorage. The Port of Valdez, southern terminus of the Alaska Pipeline, was closed on the 30th of January due to high winds.



the ***S. Michaels, Hanjin, Pohang, Marif*** and the ***Tokyo Maru***, mainly east and south of the center. During the day both the storm and the High began to fill. By the 6th conditions had eased somewhat.

❾ This storm developed out of a complex system on the 10th, near 35°N, 150°E. By the 12th it finally developed into the dominant circulation. At 0600 the central pressure was estimated at 962 mb. At 0000 the ***Skeena*** (46°N,177°E) reported a 58–kn southerly and 6 hr later her pressure was at 982 mb with a 48–kn southeasterly; by 1200 it was down to 979 mb. At 1800 the ***Zaretchie*** (54°N, 155°E) hit 58–kn northerlies, while the ***Mys Grotovy*** encountered 47–kn north northwesterlies near 59°N, 165°E. Once again the gradient was intensified by a large 1043–mb High, which dominated the northeastern North Pacific. The Low was a complex two–centered system with one center heading northwestward and the one we were tracking, moving toward the north northeast. Finally on the 14th this center swung toward the northwest and the two combined into one powerful storm. This was short–lived however and the system broke into several weak centers on the 15th.

The second half of the month while cyclonically active featured no major

Wide World

Figure 4.—Ice covered the superstructure of the Astoria, OR–based trawler ***Sea Venture****, as it made its way up the Columbia River on the 2d. Freezing ocean spray made many fishing vessel's nets inoperable and they ended up in port to wait out the cold snap.*

systems. A number of small storms caught in a squeeze between two highs or butting against a high would create gales for a short period of time. In some cases frontal systems were able to generate gales that disrupted shipping. For example on the 21st a cold front swinging off Japan generated winds of 40 to 50 kn. These winds were reported by the ***Tribulus, White Rose, Pan Fortune, Japan Alience*** and the ***Hakone Maru.***

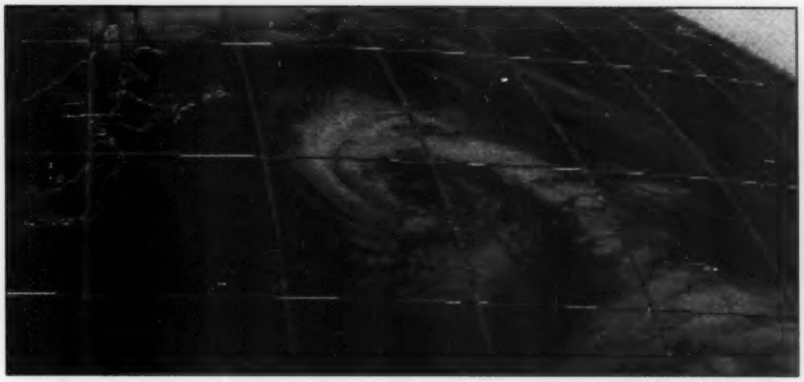
Tropical Cyclones— February is the least likely month for tropical cyclone activity in the North Pacific. This month there were no tropical storms, hurricanes or typhoons.

Casualties— See the summary on the Alaskan High at the end of this section. In addition, the 198–ton refrigerated cargo carrier ***Swallow*** (cover)ran aground entering Dutch Harbor, the chief fishing port in the Aleutian Is Chain. Two tugs tried to pull the ship free but failed.

March— The Aleutian Low disrupted the normal pressure pattern in the Pacific this month (fig 5). It usually covers the Bering Sea and Gulf of Alaska with the main center southeast of the Kamchatka Peninsula. This month it was confined to the northeastern North Pacific while a 1023–mb High extended over the Bering Sea. This resulted in anomalies up to +13 mb off Kamchatka and down to –8 mb over the northeastern North Pacific. These anomalies extended to the 700 mb level where steering patterns were disrupted. South of 40°N a storm from Tokyo would end up near Portland, OR in an ideal situation but in a less than straight path. North of 40°N the gradient was confused in the west but cyclonic in the east.

On This Date—March 22, 1979—Ten years ago Typhoon Bess reached typhoon strength in the Philippine Sea and hit a peak of 90 kn the following day.

Extratropical Cyclones— As you might expect, based on the climatic chart, cyclone activity was hot and heavy over the northeast North Pacific. In fact the track chart indicates only a small section of the western Bering Sea was immune from storms. Activity even extended below 30°N.



Satellite Applications Lab.

Figure 6.— This IR satellite photo was taken on the 18th of March, around 1200, and shows storm no. 2 while it was beginning to turn a counterclockwise loop.

❶ This interesting storm developed over the Gulf of Alaska late on the 2d and was flanked to the west by a powerful 1056-mb High, which covered the Bering Sea. The storm intensified on the 3d as it moved toward the south southwest. The following day it turned eastward. The pressure gradient to the west was intensified by the High and the ***Pestovo*** (55°N, 151°N) hit 43-kn northwesterlies in 23-ft seas at 1200 on the 4th. A vessel near 47°N, 132°W at 1800 encountered 52-kn southeast winds while battling 20-ft seas; her pressure was 984 mb. By 0000 on the 5th a number of vessels reported winds in the 40-to 50-kn category with seas up to 16 ft. Most of these reports from vessels such as the ***Young Skipper, Star Florida***, and ***Khudozhnik Zukov*** were southwest and west of the center. At 1200 the ***Skeena***, nearly 800 mi west southwest of the center, ran into 50-kn northerlies as the now 1039-mb High continued to keep the gradient tight. The Low moved southeastward and then turned a counterclockwise loop over the next several days but lost much of its punch even before this maneuver.

❷ This long-lived system got underway east of Tokyo on the 17th. It was one of several centers in a large complex system with a main center to the northeast. By the 18th the Tokyo center was dominant and turning a counterclockwise loop (fig 6). The ***German Senator*** reported a north northwest 65-kn wind at 0000 shifting to west northwest by 0600; she also encountered swells of 21 ft some 240 mi southwest of the center. Other vessels, farther away were hitting 40-to 45-kn winds. At 1200 the ***Priliv*** (37°N, 155°E) was nailed by 52-kn northwesterlies in 30-ft seas; she also reported a 982-mb pressure. On the 19th at 0000 the JNFU, about 60 mi south of the center, ran into a 62-kn blow from the west southwest, and sent in a 970-mb reading as well.

The storm completed its loop on the 20th and, after swinging southeastward, it recurved toward the northeast then north ending up over Bristol Bay on the 25th. On its way, however, it caused some problems to shipping. The Nagorsk (44°N, 175°W) at 0600 on the 23d ran into 43-kn southwesterlies and registered a 970-mb pressure. At 0000 on the 24th several vessels including the ***Nagorsk, Hohsing Breeze*** and the ***Sealand Freedom***, reported in with 45- to 50-kn winds in 16- to 23-ft seas.

❸ The month closed with a triple header. It began around the 27th. Actually the system, east of the Kuril Islands, was already a 984-mb storm on the 26th. On the 27th a wave off Tokyo formed along its cold front and late in the day another wave developed along the front near 45°N, 175°W. The initial system was soon engulfed by this latter system but should at least get credit for spawning the two remaining storms.

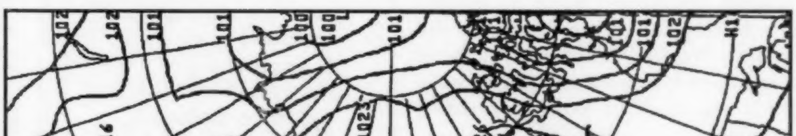


Figure 5.— The Aleutian Low normally covers the Bering Sea and Gulf of Alaska region in March. However this year it was replaced over the Bering Sea by a 1023-mb high.

Wide World

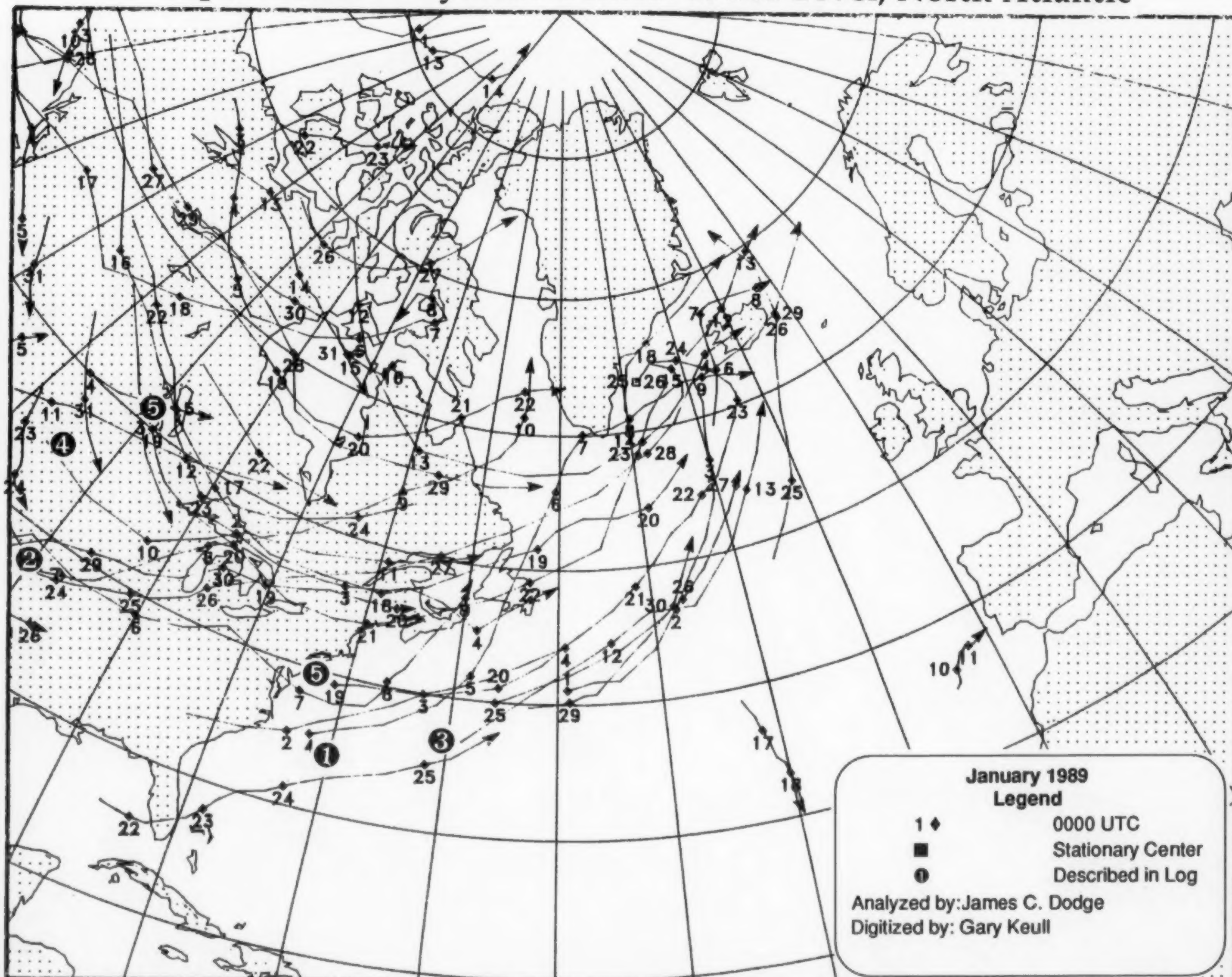
*Figure 7.—Tugboats attempt to push the 800–ft tanker **Exxon Houston** after about 117,000 gallons of fuel and crude oil spilled on the 2d in high winds and rough seas, some 15 mi from*

Neither looked like much until the 29th when both began to organize. At 1200 the Tokyo wave had a 974–mb center near 47°N, 169°E while the easternmost system had a 989–mb center near 49°N, 149°W. At 1800 the ***Nosac Takayama*** (42°N, 150°W) ran into 50–kn westerlies. The ***Keisho Maru*** (50°N, 148°W) at 0600 on the 30th also reported a 50–kn westerly while battling 23–ft swells. On the 31st the storms bunched closer together but were also weakening. The ***Rainier***, at 0000 off Vancouver Island, ran into a 47–kn southeast wind while the ***Igarka*** (53°N, 175°E) reported 43–kn north northwesterlies at 0600. By 1200 the Tokyo system was in control but was showing little life. However the system remained nearly stationary, with several centers, into the 1st, resulting in gale force winds along the southern periphery of the large complex.

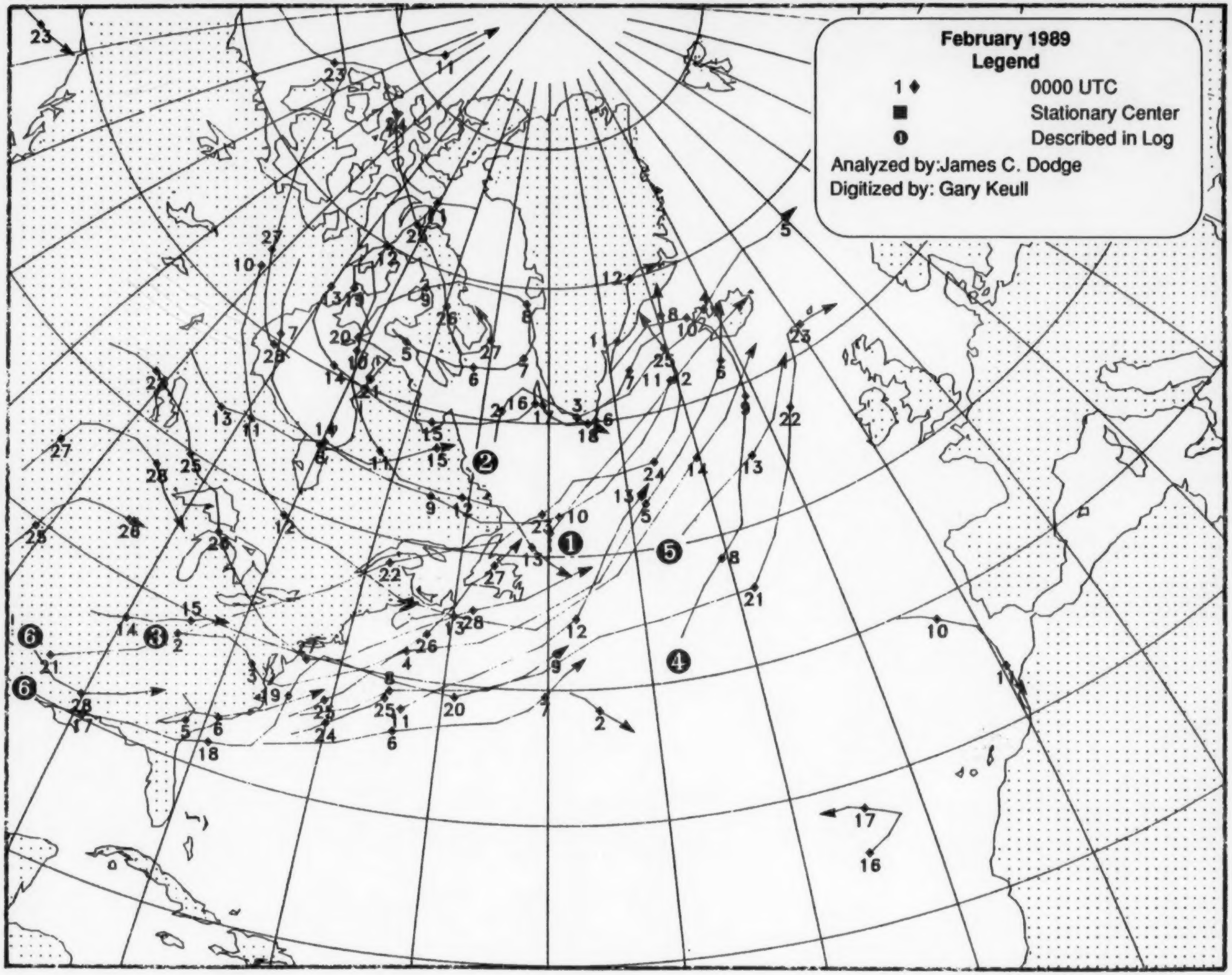
Tropical Cyclones— While an average of one tropical cyclone forms in the western North Pacific every 2 yr in March, none formed this year or since 1982. In the east none have been recorded.

Casualties— The 800–ft, 73,212–ton tanker ***Exxon Houston*** broke anchorage in rough seas and ran aground off Oahu on the 3d (fig 7). It was estimated that she spilled some 117,000 gallons of crude oil, which threatened the Honolulu and Waikiki beaches some 15 mi away. Assessment of the damage, at first, was hampered by 12–ft waves. The ***Exxon Yorktown*** came to her assistance and took the remaining 3.7 million gallons of crude.

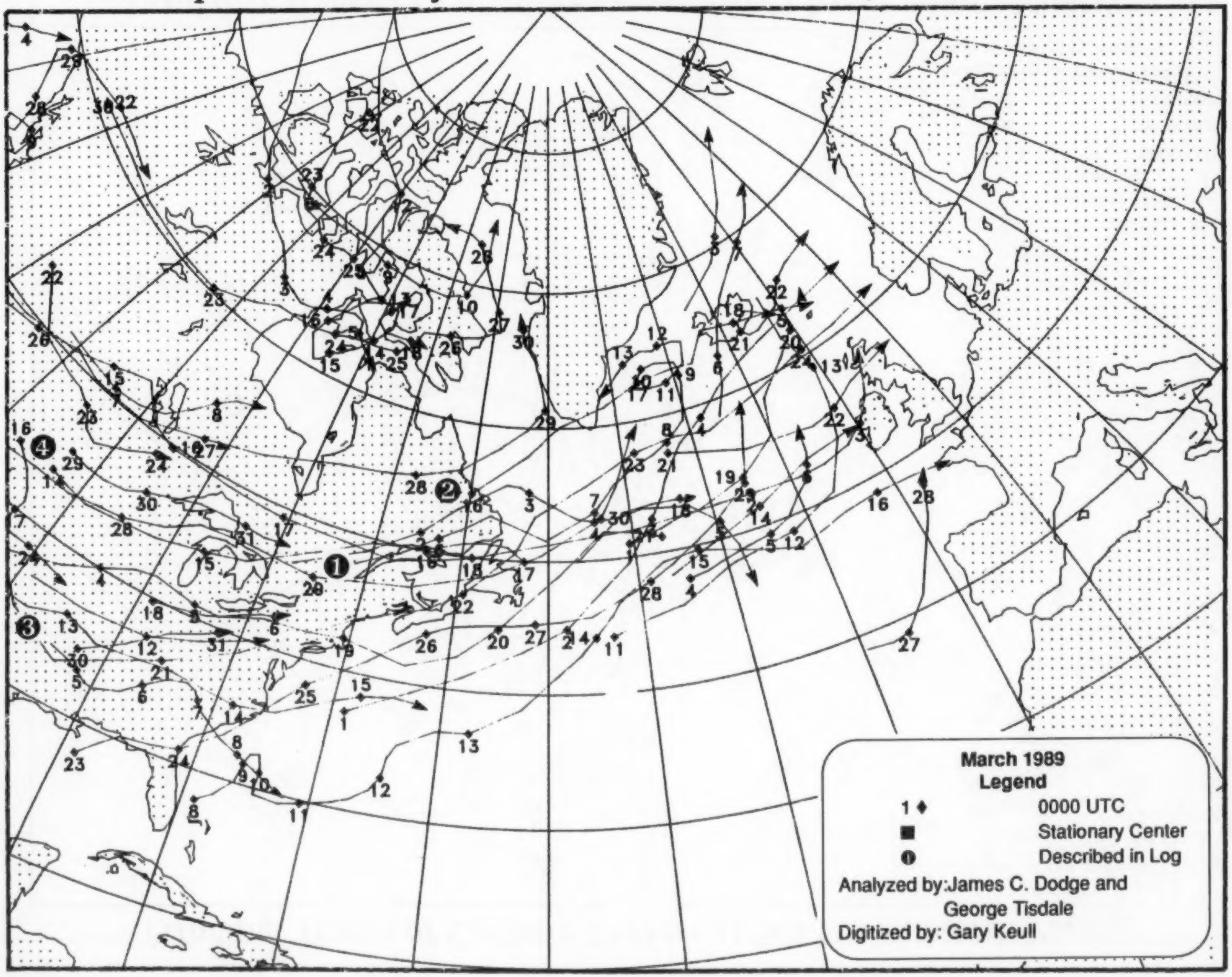
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



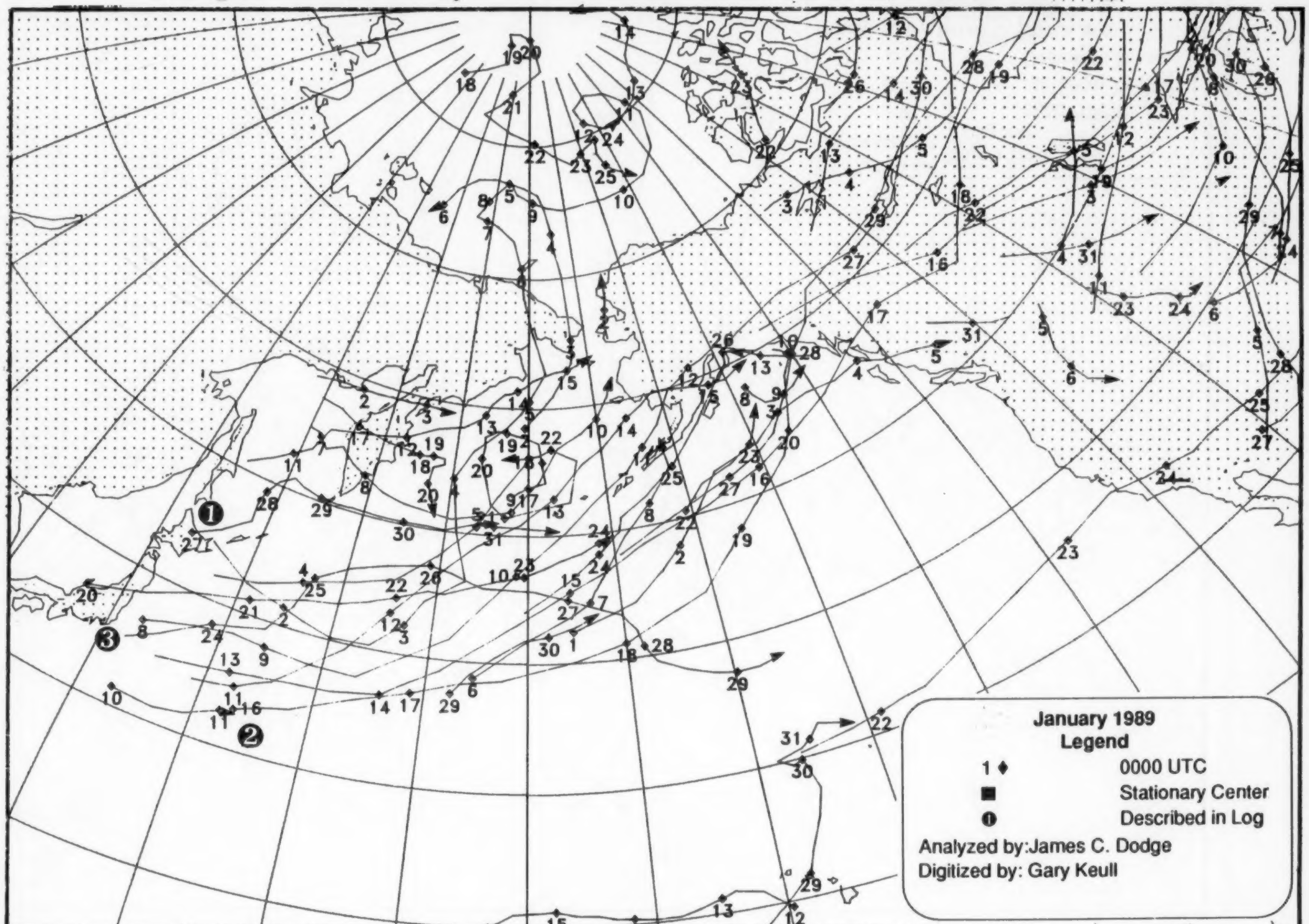
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



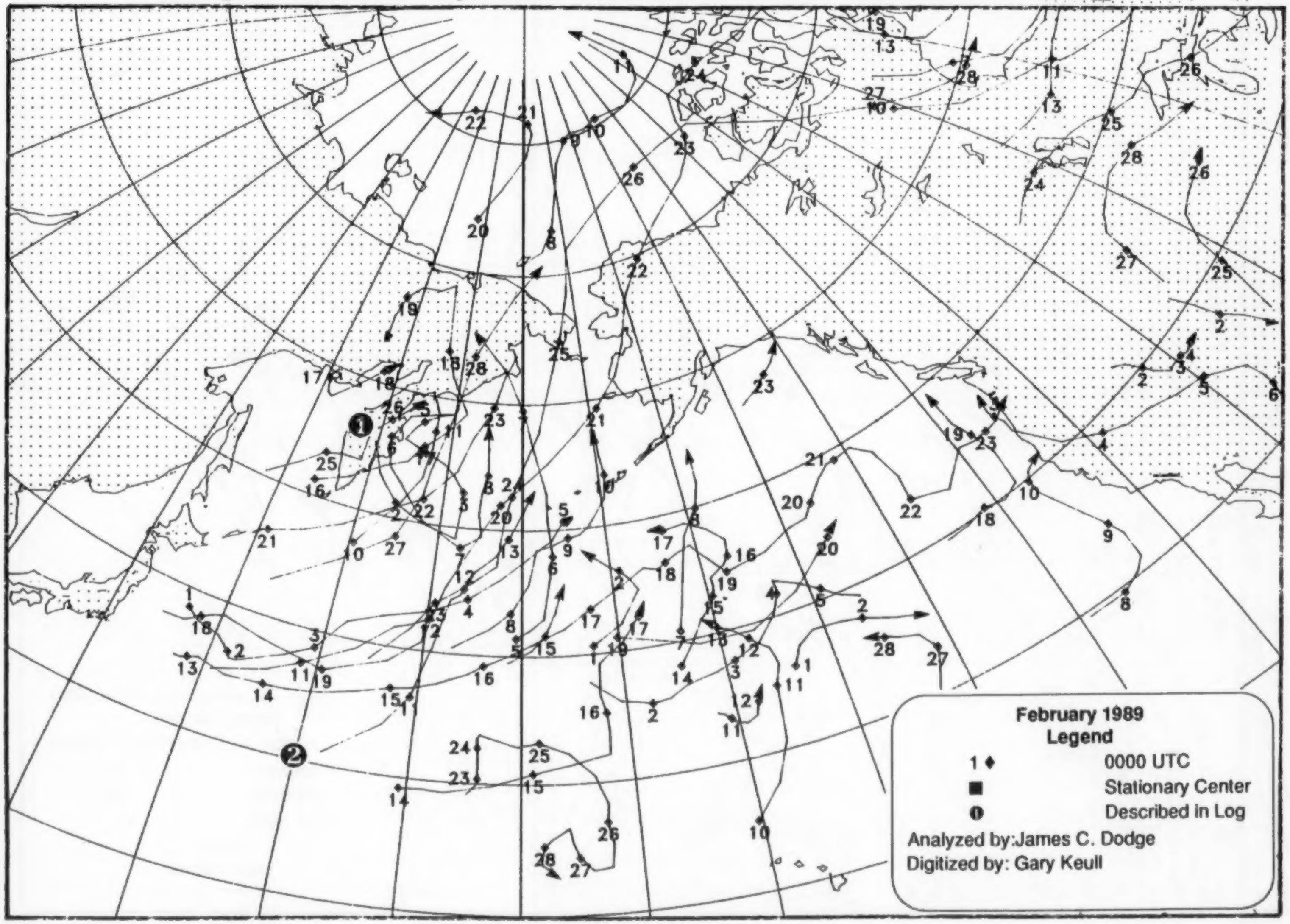
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



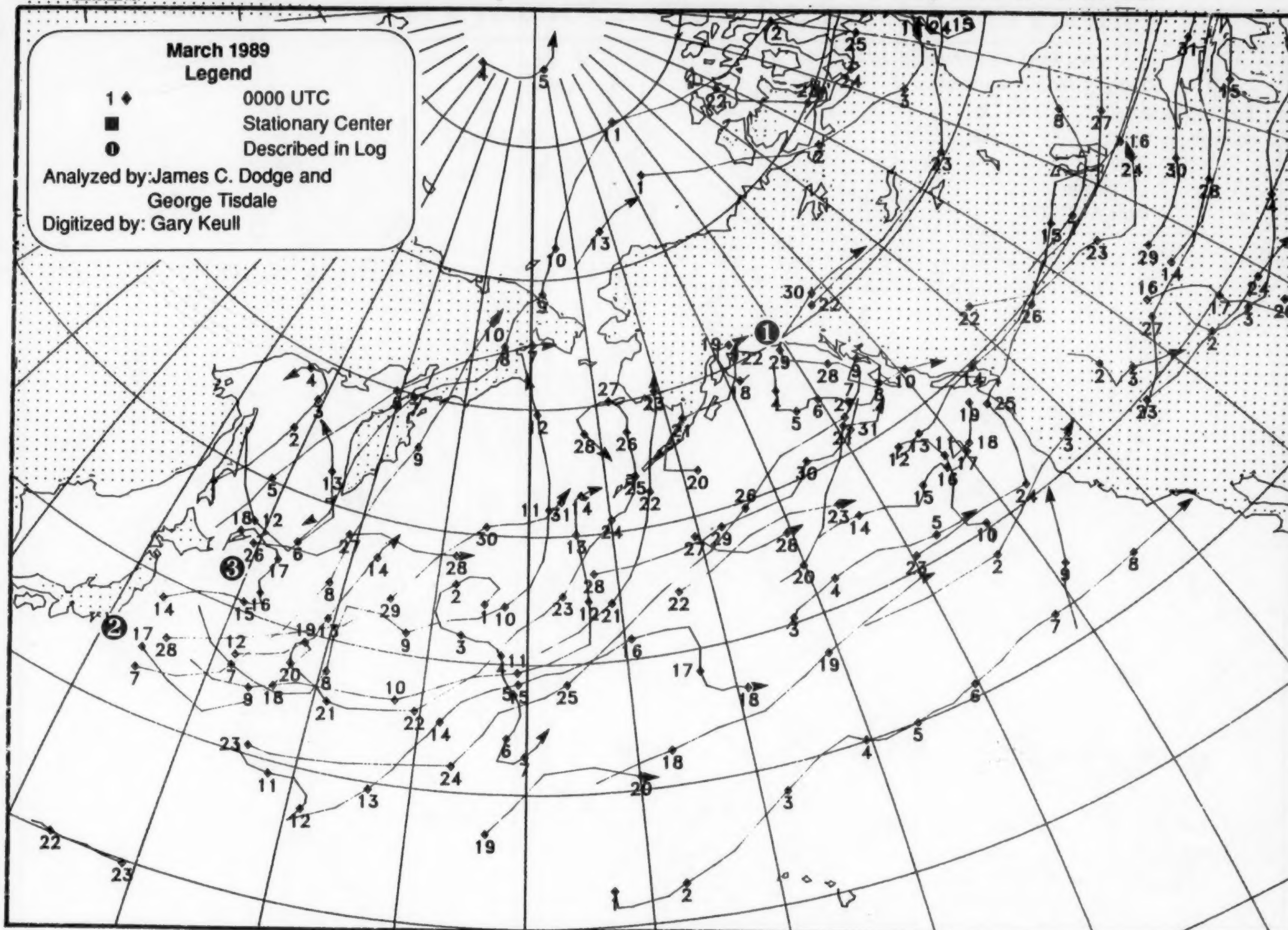
Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



January, February and March 1989

VESSEL	SHIP CALL	DATE	POSITION LAT. deg.	POSITION LONG. deg.	TIME GMT	WIND DIR. 10 deg.	WIND SPEED kts.	VSBY	PRES WX. code	PRESS-URE abs.	TEMP deg C. Air	TEMP deg C. Sea	SEA WAVES PD. sec	SEA WAVES HGT. ft.	SWELL WAVES DIR	SWELL WAVES PD. sec	SWELL WAVES HGT. ft.
	PACIFIC	JAN.															
ACE ACCORD	DULV	1	54.2 N	170.2 W	00	26	M 60	.25 NM	41	0996.0	1.0	7.0	20	31	24	18	32.5
EVER SUMMIT	BKHU	1	55.7 N	150.5 W	12	28	M 48	5 NM	01	1005.0	4.0	4.0	12	26	28	16	32.5
SANSINENA II	WSIN	1	54.9 N	140.6 W	18	29	M 46	5 NM	15	1002.5	3.9	5.6	6	24.5	26	12	39
SKAUBORD	LADC2	2	36.8 N	168.6 E	12	15	M 48	2 NM	81	1011.0	15.0	19.0	6	31	15	6	31
EVER SUMMIT	BKHU	4	53.2 N	179.6 W	12	25	M 55	2 NM	50	0985.0	3.0	2.0	14	32.5	25	16	39
SEALAND KODIAK	KGTZ	15	57.9 N	146.9 W	06	30	M 48	10 NM	01	0990.0	0.6	3.9	3	6.5	29	6	29.5
SEALAND KODIAK	KGTZ	15	58.6 N	149.4 W	12	29	M 45	10 NM	01	0990.0	- 2.2	5.8	3	6.5	29	7	29.5
EXXON LONG BEACH	WHCA	18	49.6 N	134.6 W	00	26	M 55	2 NM	40	1007.0	9.0		13	32.5	24	15	36
	OXGA2	19	44.3 N	149.8 W	12	26	M 50	10 NM		1003.0	6.5		8	13	26	12	29.5
SEALAND TACOMA	KGTY	21	52.2 N	132.4 W	00	27	M 45	10 NM	01	1001.7	4.4	6.2	3	13	26	7	32.5
EVER SUMMIT	BKHU	26	49.7 N	177.7 W	00	27	M 45	2 NM	57	0992.0	1.0	2.0	8	24.5	09	10	29.5
EVER SUMMIT	BKHU	26	50.4 N	174.7 W	12	09	M 60	.25 NM	41	0988.0	- 1.0	- 1.0	14	39	09	16	42.5
M/V MARINE RELIANCE	WHEJ	27	29.2 N	173.8 E	06	33	M 45	5 NM		1021.0	17.0		3	10	32	12	36
EVER SUMMIT	BKHU	27	50.7 N	170.1 W	12	06	M 54	.25 NM	77	1002.0	- 6.0	2.0	16	32.5	06	15	39
UNI-SPRING	BKHU	28	44.2 N	147.8 E	06	31	M 56	1 NM	96	0991.0	5.0	3.0	7	26	11	11	29.5
PRESIDENT TYLER	WEZM	31	54.0 N	178.7 E	00	13	50	1 NM	51	1000.3	1.7	1.7	10	19.5	10	14	44
	ATLANTIC	JAN.															
GALVESTON BAY	WPUF	5	40.1 N	42.6 W	18	19	M 45	2 NM		1007.0	19.4	16.1	5	8	22	8	39
LYRA	WSDG	6	39.2 N	37.5 W	18	18	45			1022.0	19.0		10	23	28	14	29.5
RAINBOW HOPE	KNDB	20	62.9 N	20.4 W	12	21	50	2 NM	84	0995.0	5.6		8	14.5	21	10	39
AMERICAN VIRGINIA	WPVD	21	41.7 N	40.4 W	06	28	M 48	2 NM	25	1005.0	10.0		8	26	27	10	29.5
AMERICAN ALABAMA	WPKD	22	37.9 N	56.8 W	06	27	M 45	5 NM	02	1013.0	15.7		5	16.5	28	10	36
	IBKL	28	40.3 N	52.0 W	00	19	M 60	2 NM		1009.0	17.0	18.0	9	29.5			
	PACIFIC	FEB.															
NATIONAL DIGNITY	DZAG	3	47.4 N	154.9 W	18	05	M 45	.5 NM	51	1023.0	4.0	4.0	10	23	11	14	29.5
ARNOLD MAERSK	OZGI2	3	48.8 N	158.7 W	18	10	50	2 NM		1022.0	4.0		10	26	09	10	29.5
ARNOLD MAERSK	OZGI2	4	49.2 N	155.8 W	06	12	50	2 NM	69	1027.0	3.0		8	16.5	10	12	36
PRESIDENT F. ROOSEVELT	KRJF	4	39.5 N	165.6 E	12	27	M 57	2 NM	26	0993.8	3.9	10.6	7	29.5	29	12	29.5
PRESIDENT F. ROOSEVELT	KRJF	4	39.6 N	168.3 E	18	28	M 55	1 NM	88	0993.1	3.9	10.0	8	24.5	29	15	29.5
ARNOLD MAERSK	OZGI2	4	49.5 N	153.2 W	18	12	45	5 NM		1034.0	3.0		10	19.5	11	10	32.5
MARIF	DUNP	5	54.3 N	164.8 W	00	13	M 59	1 NM	55	1022.0	3.0		7	26	33	9	39
ARNOLD MAERSK	OZGI2	5	49.6 N	151.4 W	00	11	45	5 NM		1035.0	4.0	6.0	10	19.5	11	10	32.5
GREEN BAY	KGTH	12	37.0 N	175.3 E	06	27	M 45	5 NM		0992.6	11.0		6	14.5	20	9	31
PAN FORTUNE	3ENP2	21	41.5 N	145.8 E	00	27	M 50	2 NM		1010.0	3.0	5.0	XX	32.5	27	11	32.5
GREEN MASTER	3ESV3	22	53.6 N	154.6 W	18	34	M 58			1012.0	4.0	3.2	12	42.5	34	12	42.5
MING FORTUNE	BLHA	26	33.1 N	146.2 E	00	20	M 48	2 NM		1007.5	20.0				20	8	29.5
	ATLANTIC	FEB.															
CHERRY VALLEY	WIBK	18	45.4 N	16.3 W	00	23	45	5 NM	03	1008.8	14.4	10.6	9	29.5	25	15	32.5
CHESAPEAKE BAY	WMLH	18	44.4 N	33.7 W	12	26	M 49	10 NM	01	1009.5	7.8		9	29.5	27	9	29.5
	PACIFIC	MAR.															
PRESIDENT JEFFERSON	WPGE	1	49.8 N	151.1 W	00	04	45	5 NM	14	1025.7	3.3	3.3	6	29.5			
MARCHEN MAERSK	OWDQ2	1	43.0 N	153.3 W	23	06	M 49	5 NM		1008.2	8.2	8.8	12	29.5			
SEALAND DEVELOPER	KHRH	4	52.1 N	156.0 W	00	32	M 50	2 NM	26	1007.2	- 0.2	2.0	7	8	33	8	32.5
SEALAND DEVELOPER	KHRH	4	51.9 N	157.8 W	06	34	M 50	2 NM	26	1012.0	- 0.2	2.0	7	8	34	8	32.5
SEALAND DEVELOPER	KHRH	4	51.7 N	159.7 W	12	34	M 50	2 NM	26	1014.0	0.0	2.0	7	8	34	8	32.5
SANSINENA II	WSIN	4	57.8 N	149.9 W	18	02	M 45	5 NM	02	0995.0	0.0	3.3	8	26	06	10	29.5
LUZON SAMPAGUITA	DUPG	5	48.5 N	129.7 W	00	14	M 45	.5 NM		0984.0	8.0	6.0	9	29.5	15	8	31
UNI-SPRING	BKHU	18	35.8 N	157.5 E	18	31	M 48	1 NM	60	0984.0	9.0	15.0	7	32.5	12	10	39
UNI-SPRING	BKHU	19	35.7 N	159.1 E	00	27	M 46			0988.0	10.0	15.0	6	29.5	07	10	36
PACDUCHESS	ABVI	20	42.3 N	164.4 E	12	07	M 48	1 NM	58	0999.0	4.0	8.0			11	8	29.5
PACDUCHESS	ABVI	21	42.8 N	161.0 E	00	07	M 53	.5 NM	51	1007.0	3.0	5.0	12	32.5	04	6	13
LARS MAERSK	OXND2	26	41.2 N	155.5 E	06	27	52	2 NM		0998.9	6.0	8.0	6	32.5			
SEALAND INNOVATOR	WGKF	26	42.9 N	149.6 E	09	30	M 48	2 NM	68	0996.0	0.0		6	13	28	9	34.5
LEXA MAERSK	OXFB2	26	41.7 N	154.1 E	12	28	58	2 NM	63	0997.0	3.0		12	32.5			
LARS MAERSK	OXND2	26	42.0 N	157.9 E	12	27	50	5 NM		0998.0	4.8	7.8	6	29.5			
	ATLANTIC	MAR.															
SEALAND PERFORMANCE	KRPD	1	45.5 N	32.2 W	18	30	45			1002.2	12.0		10	29.5	30	10	32.5
SEALAND QUALITY	KRHJ	2	44.4 N	21.1 W	12	26	M 45	10 NM	01	1010.0	14.5		9	26	26	9	29.5
SEALAND QUALITY	KRHJ	4	41.9 N	39.0 W	21	30	M 47	5 NM	02	1008.0	6.4	16.1	7	14.5	29	9	29.5

January, February and March 1989

Ship Name	radio	mail
1ST LT ALEX BONNYMAN	17	1
1ST LT BALDOMERO LOPEZ	37	106
1ST LT JACK LUMMIS	58	107
2ND LT. JOHN P. BOBO	22	
A. V. KASTNER	120	
ABBEY	153	
ACADIA FOREST	42	
ACE ACCORD	108	185
ACE ENTERPRISE	24	183
ACT II	40	
ACT III	173	
ACT 12	69	
ACT 5	146	
ACT 6	155	
ACT 7	174	
ACT 9	127	
ACT I	73	
ACT IV	167	
ADABELLE LYKES	62	
ADDIRIYAH	50	69
ADMIRALTY BAY	27	11
ADONIS	15	
ADRIAN MAERSK	21	50
AFRICAN FERN	88	108
ALAIN LD	14	
ALASKA MARU	11	
ALASKA RAINBOW	34	155
ALBERT MAERSK	5	24
ALDEN W. CLAUSEN	32	122
ALEMANIA EXPRESS	77	
ALLIGATOR FORTUNE	25	38
ALLIGATOR GLORY	37	
ALLIGATOR HOPE	77	175
ALLIGATOR LIBERTY	42	
ALLIGATOR TRIUMPH	42	154
ALLISON LYKES	1	
ALMERIA LYKES	49	99
ALTAMONTE	43	55
ALVA MAERSK	20	22
AMBASSADOR	55	98
AMBASSADOR BRIDGE	57	23
AMERICA EXPRESS	52	
AMERICAN ALABAMA	44	145
AMERICAN CONDOR	16	23
AMERICAN CORMORANT	13	
AMERICAN EAGLE	62	117
AMERICAN FALCON	28	96
AMERICAN KESTREL	14	
AMERICAN MAINE	33	130
AMERICAN NEW YORK	85	138
AMERICAN RESOLUTE	39	30
AMERICAN TROJAN	37	63
AMERICAN UTAH	66	183
AMERICAN VIRGINIA	56	180
ANTHONY RAINBOW	42	122
AQUA CITY	51	203
AQUA GARDEN	34	124
AQUARIUS	77	171
ARCO ALASKA	14	6
ARCO ANCHORAGE	18	33
ARCO CALIFORNIA	24	40
ARCO FAIRBANKS	24	41
ARCO JUNEAU	27	15
ARCO PRUDHOE BAY	15	30
ARCO SAG RIVER	17	
ARCO SPIRIT	6	
ARCO TEXAS	29	41
ARCTIC TOKYO	7	121
ARGONAUT	41	125
ARIES	2	
ARILD MAERSK	39	113
ARIOSTO AMADO	85	
ARMCO	4	14
ARNOLD MAERSK	42	90
ARTHUR M. ANDERSON	4	7
ASHLEY LYKES	49	
ASPEN	38	102
ASTORIA	141	
ATIGUN PASS	115	265
ATLA	2	15
ATLANTIC	122	46
ATLANTIC CARTIER	50	
ATLANTIC COMPANION	94	
ATLANTIC CONVEYOR	122	
ATLANTIC RAINBOW	23	27
ATLANTIC SPIRIT	71	135
AURORA ACE	127	
AUSTANGER	11	34

Ship Name	radio	mail
AUSTRAL RAINBOW	66	136
B.T. ALASKA	12	3
B.T. SAN DIEGO	71	225
BAAB ULLAH	53	91
BACTAZAR	70	165
BADGER	1	90
BALTIMORE TRADER	10	9
BANGLAR KALLOL		41
BAR' ZAN	28	27
BARRYDALE	159	
BAY BRIDGE	90	
BCR KING	9	
BEER SHEVA	10	
BHARATENDU	13	
BIBI	142	
BISLIG BAY	32	
BLUE HAWK	100	
BOGASARI LIMA	4	10
BOLIVAR	9	27
BONITA	21	52
BRIGIT MAERSK	35	95
BRILLIANT ACE	65	
BROOKLYN BRIDGE	205	
BROOKS RANGE	42	51
BUNGA KENANGA	3	
BUNGA KESIDANG	20	30
BUNGA MELAWIS	2	
BUNGA TEMBUSU	87	104
C.MEHMET	11	
CAGUAS	3	51
CALIFORNIA HERMES	48	23
CALIFORNIA ZEUS	40	
CALYPSO		26
CANADIAN RAINBOW	13	167
CAPE BYRON	59	
CAPE ROGER	87	
CAPE YORK	143	
CAPRICORN	6	11
CARIBE I	3	53
CAROLINA	38	116
CASON J. CALLAWAY	19	29
CASUARINA	1	17
CELEBRATION	15	161
CGM CALIFORNIA	101	72
CGM LORRAINE	34	
CHABLIS	24	45
CHACO	16	
CHARLES PIGOTT		72
CHARLOTTE LYKES	100	103
CHELSEA	16	30
CHEMICAL PIONEER	78	104
CHERRY VALLEY	28	88
CHESAPEAKE BAY	32	135
CHESAPEAKE TRADER	24	59
CHESNUT HILL	11	26
CHEVRON ANTWERP	22	96
CHEVRON ARIZONA	30	79
CHEVRON BURNABY	99	168
CHEVRON CALIFORNIA	117	177
CHEVRON COLORADO	1	24
CHEVRON EDINBURGH	54	205
CHEVRON EQUATOR	30	146
CHEVRON FELUY		32
CHEVRON LONDON		216
CHEVRON LOUISIANA	32	85
CHEVRON METEOR	30	43
CHEVRON MISSISSIPPI	65	113
CHEVRON NAGASAKI		210
CHEVRON OREGON	79	199
CHEVRON PACIFIC	57	127
CHEVRON SKY		215
CHEVRON STAR		80
CHEVRON SUN	3	155
CHICKASAW	46	
CHRISTINA	140	
CIELO DI VENEZIA	1	
CITADEL HILL	37	
CLEMENT	156	
CLEMENTINA	5	
CLEVELAND	2	
CO-OP EXPRESS I	40	
CO-OP EXPRESS II	10	68
COAST RANGE	12	42
COASTAL MANATEE	23	24
COLIMA	45	49
COLUMBUS AMERICA	198	
COLUMBUS AUSTRALIA	59	
COLUMBUS CANADA	79	

Ship Name	radio	mail
COLUMBUS LOUISANA	83	
COLUMBUS NEW ZEALAND	151	
COLUMBUS OHIO	9	
COLUMBUS VICTORIA	149	
COLUMBUS VIRGINIA	154	
COLUMBUS WELLINGTON	149	
CONCERT EXPRESS	78	
CONTENDER ARGENT	84	
CONTINENTAL HIGHWAY	15	
CORAH ANN	4	56
CORMORANT ARROW	50	
CORNUCOPIA	104	114
CORONADO	19	66
CPL. LOUIS J. HAUGE JR	35	54
CURRENT	74	69
CYGNUS	21	56
CYPRESS PASS	61	40
CYPRESS TRAIL	41	78
D.L. BOWER		199
DAMIOS DE GOIS	59	
DAMAN	1	
DELAWARE BAY	30	
DELAWARE TRADER	69	121
DIANA	4	31
DILIGENCE TRADER	31	
DOCK EXPRESS TEXAS	12	125
DREDGE WHEELER	9	28
DUBHE	33	
DUSSELDORF EXPRESS	52	
E.R. BRUSSEL	62	154
EASTERN FRIENDSHIP	23	108
EASTERN GLORY	46	113
EASTERN VENTURE	20	142
EDGAR M. QUEENY	37	42
EDWARD L. RYERSON	13	6
EL GAUCHO	26	56
ELBE MARU	54	
ELIZABETH LYKES	34	28
EMERALD SEA	146	121
ENDEAVOR	8	17
ENSOR	15	98
EUPEN	9	
EVER GAINING	61	
EVER GARDEN	3	
EVER GATHER	3	
EVER GENERAL	9	9
EVER GENIUS	5	6
EVER GENTLE	26	
EVER GIANT	12	14
EVER GIFTED	13	39
EVER GIVEN	6	8
EVER GLAMOUR	22	6
EVER GLEAMY	8	
EVER GLEEFUL	18	19
EVER GLOBE		10
EVER GLORY	13	
EVER GLOWING		5
EVER GOING	5	12
EVER GOLDEN	4	
EVER GOODS	2	
EVER GOVERN	3	24
EVER GRACE	12	8
EVER GRADE	5	17
EVER GRAND	19	21
EVER GROUP	12	16
EVER GROWTH	4	9
EVER GUARD	37	69
EVER GUIDE	21	15
EVER LAUREL	22	18
EVER LEVEL	22	
EVER LOADING	20	
EVER SUMMIT	53	178
EVER VIGOR	7	22
EVER VITAL	2	
EXPORT FREEDOM	32	122
EXPORT PATRIOT	35	122
EXXON BALTIMORE	11	12
EXXON BATON ROUGE	3	13
EXXON BAYTOWN	6	8
EXXON BENICIA	50	26
EXXON HOUSTON	4	
EXXON LONG BEACH	24	17
EXXON NEW ORLEANS	6	7
EXXON NORTH SLOPE	16	31
EXXON PHILADELPHIA		14
EXXON PRINCETON	2	3
EXXON SAN FRANCISCO	14	17
EXXON VALDEZ	8	2

Ship Name	radio	mail
EXXON WASHINGTON	7	8
EXXON YORKTOWN	25	24
FALCON LEADER	57	
FALSTRIA	48	119
FERNCROFT	123	141
FETISH		50
FINNROSE	40	134
FLORIDA RAINBOW	57	133
FORTALEZA	25	223
FRANCIS SINCERE NO. 6	26	
FRANKFURT	2	
FREDERICKSBURG	63	49
FROTASIRIUS	30	
GALVESTON BAY	64	164
GATEWAY EAST	68	185
GEMINI	69	152
GENERAL HIZON	12	
GENERAL M.BELGRANDO	8	
GENERAL ROXAS	1	
GENEVIEVE LYKES	4	7
GEORGE H. WEYERHAEUSER	25	68
GEORGE WASHINGTON BRID	221	
GEORGIA		112
GLACIER BAY	56	77
GLENEAGLES	102	142
GLOBAL WING	30	92
GLORIA	10	
GLORIOUS SPICA	70	
GOLAR PETROSUN	1	
GOLDEN APO	37	28
GOLDEN BEAR	61	
GOLDEN BLISS	58	
GOLDEN ENDEAVOR	25	36
GOLDEN GATE	4	42
GOLDEN GATE BRIDGE	228	67
GOLDEN HAWK	54	125
GOLDEN HILL		4
GRAIGLAS	225	
GREAT LAND	257	123
GREEN ANGELES	6	56
GREEN BAY	34	280
GREEN ELLIOTT		48
GREEN HARBOUR	36	50
GREEN HAWK	9	
GREEN ISLAND	95	79
GREEN LAKE	61	106
GREEN MASTER	43	87
GREEN MAYA	55	72
GREEN RAINIER	24	103
GREEN RIDGE	94	135
GREEN SAIKAI	7	34
GREEN SASEBO	68	180
GREEN STAR	35	159
GREEN VALLEY	18	
GREEN WAVE	84	92
GUANAJUATO	176	171
GULF IDEAL	63	
GYPSUM BARON	128	
GYPSUM COUNTESS	20	
GYPSUM KING	273	
HAI JUNG	18	
HAMBURG	1	
HANEI PEARL	16	
HANEI SKY	25	116
HANEI SUN	41	47
HANJIN CHEJU		13
HANJIN KEELUNG	42	19
HANJIN KOBE	16	20
HANJIN KUNSAN	38	27
HANJIN KWANGYANG	18	16
HANJIN LONG BEACH	4	
HANJIN NEW YORK		18
HANJIN SAVANNAH	23	
HANJIN SEATTLE	1	
HANJIN SEOUL	48	16
HANJIN YOKOHAMA	16	6
HARMAC DAWN	83	
HASSAN MERCHANT	57	82
HAWAIIAN RAINBOW	58	
HAWTHORN HILL	16	63
HEIDE	33	
HENRY HUDSON BRIDGE	201	
H[illegible]MENIA	22	
HIRA *2	81	
HOEGH CAIRN	22	25
HOEGH CLIPPER	9	29
HOEGH DENE	10	86
HOEGH DRAKE	23	22
HOEGH DYKE	9	
HOHSING BREEZE	25	51
HOJIN MARU	56	
HOLIDAY	20	36
HONESIA	73	271
HONOLULU	127	

Ship Name	radio	mail
HAELJIN	57	
HUAL ROLITA	7	
HUAL TRANSPORTER	42	133
HUMACAO	30	135
HUMBER ARM	41	102
HYUGA MARU	16	
HYUNDAI *103	1	
HYUNDAI *107	15	20
HYUNDAI CHALLENGER	56	
HYUNDAI COMMANDER	59	51
HYUNDAI EXPLORER	5	1
HYUNDAI INNOVATOR	8	13
HYUNDAI PIONEER	49	59
IBIS ARROW	22	
IMPERIAL	6	
INCOTRANS PACIFIC	112	
INFANTA	135	
INGER	56	151
IRMA M	174	
ISLAND PRINCESS	178	
ITANAGE	53	48
ITAPE	4	
ITB PHILADELPHIA	109	179
JADRAN EXPRESS	21	
JALISCO	34	107
JAMES LYKES	7	122
JAPAN ALLIANCE	89	74
JAPAN APOLLO	124	149
JEAN LYKES	17	69
JO BIRK	45	
JO CLIPPER	51	
JO CYPRESS	47	
JO GRAN	15	28
JO LONN	171	
JO OAK	2	
JOHANNA OLDENDORFF	50	
JOHN G. MUNSON	6	6
JOHN LYKES	12	21
JOSEPH LYKES	10	22
JOVIAN LILY	75	212
JUBILEE		4
JULIUS HAMMER	57	130
KALIDAS	95	
KAUAI	87	209
KEE LUNG	8	62
KEISHO MARU	102	62
KENAI	12	49
KENNETH E. HILL	28	74
KENNETH T. DERR	17	19
KENT	51	125
KENTUCKY HIGHWAY	99	
KEYSTONE CANYON	25	152
KEYSTONER	43	174
KIILSA		40
KISO	128	
KITTANNING	11	18
KOLN EXPRESS	61	
KOPER EXPRESS	32	
KOREAN WONIS JIN	16	16
KOREAN WONIS ONE	38	18
KOREAN WONIS SEVEN	34	
KORYU MARU	30	37
KUROBE	78	
L.T. ARGOSY	44	84
LA PAMPA	2	
LANCASHIRE	1	
LARS MAERSK	12	50
LASH ATLANTICO		19
LAURA MAERSK	10	29
LAWRENCE A. GIANELLA	48	
LEDA MAERSK	33	97
LEISE MAERSK	15	83
LEO TEMPEST	53	
LERMA	110	
LESLIE LYKES	15	
LETITIA LYKES	20	
LEXA MAERSK	27	78
LIBERTY STAR	24	89
LIBERTY SUN	78	209
LIBERTY WAVE	2	
LICA MAERSK	29	53
LING LEO	63	186
LIONS GATE BRIDGE	53	74
LIRCAY	32	
LLOTD ITAJAI	93	
LLOYD ALTAMIRAP	1	
LLOYD ARGENTINA	8	
LLOYD MARANHAO	171	308
LLOYD SAO PAULO	109	
LLOYD VITORIA	85	
LNG TAURUS	5	171
LONG LINES	30	78
LOTUS ACE	109	
LOUIS MAERSK	47	83

Ship Name	radio	mail
LOUISE LYKES	20	24
LOUISIANA BRIMSTONE	39	119
LOUISIANA MAMA	28	55
LT. ODYSSEY	7	
LURLINE	55	202
LUZON	36	170
LUZON SAMPAGUITA	7	17
LYRA	33	44
M. P. GRACE	32	
M/V MARINE RELIANCE	27	77
MACKINAC BRIDGE	212	45
MADAME BUTTERFLY	45	
MAERSK CONSTELLATION	64	116
MAERSK SUN	23	75
MAERSK TACOMA	46	
MAERSK WIND	119	158
MAGALLANES	22	52
MAJ STEPHEN W PLESS MP	19	17
MAKILING	53	63
MALINI	42	20
MALLORY LYKES	49	121
MANGAL DESAI	7	
MANHATTAN BRIDGE	165	
MANILA PROSPERITY	7	30
MANINGNING	72	138
MANUKAI	63	188
MANULANI	48	125
MANYAS-1	1	
MARATHA MAJESTY	49	59
MARCHEN MAERSK	40	127
MARGARET LYKES	88	108
MARGRETHE MAERSK	33	63
MARIA TOPIC	18	
MARIF	32	44
MARIT MAERSK	38	73
MARITIME ASSOCIATE	113	134
MARJORIE LYKES	52	
MARLIN		112
MASON LYKES	47	65
MATSONIA	56	224
MAUI	87	205
MAWASH TAPUK	23	
MAYA NO.5		62
MC KINNEY MAERSK	45	183
MEDALLION	85	107
MEDUSA CHALLENGER	5	10
MELBOURNE HIGHWAY	31	46
MELGAR BAY	23	95
MELVILLE	123	257
MERAK EIGHTY	76	102
MERCANDIAN CONTINENT	25	25
MERCANDIAN SUN II	52	107
MERIDA	46	98
MICHIGAN HIGHWAY	35	
MICRONESIAN INDEPENDEN	93	130
MIDDLETOWN	5	5
MINERVA	19	
MING FORTUNE	28	67
MING GALAXY	1	16
MING MOON	20	
MING OCEAN	12	
MING STAR		4
MING SUN	10	
MITLA	16	143
MOANA PACIFIC	184	149
MOANA WAVE	61	
MOBIL ARCTIC	20	175
MOBIL MERIDIAN	176	216
MOKU PAHU	84	46
MONSUN	25	
MORELOS	54	94
MORMACSKY	59	122
MORMACSTAR	61	167
MORMACSUN	78	203
MOSEL EXPRESS	143	
MOSMAN STAR	4	
MSC CHIARA	14	44
MSC SABRINA	33	76
NADA 2	52	222
NANCY LYKES	39	3
NATIONAL DIGNITY	38	128
NATIONAL HONOR	35	103
NATIONAL PRIDE	13	62
NAVIOS ENTERPRISE	8	
NAVIOS UNIQUE	120	
NECHES		23
NEDLLOYD ELBE	142	
NEDLLOYD HUDSON	49	142
NEDLLOYD KATWIJK	124	
NEDLLOYD KEMBLA	72	
NEDLLOYD KINGSTON	95	
NEDLLOYD KYOTO	122	
NEDLLOYD ROCHESTER	139	
NEDLLOYD ROSARIO	25	

Ship Name	radio	mail
NEDLLOYD ROTTERDAM	76	
NEDLLOYD ROUEN	111	
NEDLLOYD VAN CLOON	23	
NEPTUNE ACE	26	
NEPTUNE AMBER	122	112
NEPTUNE CORAL	67	
NEPTUNE DIAMOND	220	
NEPTUNE GARNET	29	
NEPTUNE IVORY	61	
NEPTUNE JADE	77	
NEPTUNE PEARL	44	
NEPTUNE TOURMALINE	5	
NEW INDEPENDENCE	59	145
NEW NOBLE	17	60
NEW RUBY	24	38
NEW TURQUOISE	2	
NISSAN LAUREL	15	
NOAA DAVID STARR JORDA	66	104
NOAA SHIP ALBATROSS IV	248	263
NOAA SHIP CHAPMAN	181	215
NOAA SHIP DELAWARE II	202	291
NOAA SHIP DISCOVERER O	309	214
NOAA SHIP FERREL	90	109
NOAA SHIP HECK 591	9	24
NOAA SHIP M. BALDRIDGE	39	21
NOAA SHIP MILLER FREEM	419	509
NOAA SHIP MT MITCHEL	194	223
NOAA SHIP OREGON II	183	218
NOAA SHIP RAINIER	63	
NOAA SHIP RUDE 590	4	6
NOAA SHIP SURVEYOR	199	80
NOAA SHIP T. CROMWELL	352	268
NORDHVAL	1	
NORWAY	3	6
NOSAC EXPRESS		84
NOSAC RANGER	6	
NOSAC SKAUKAR	36	66
NOSAC SKY	77	50
NOSAC TAI SHAN	1	4
NOSAC TAKAYAMA	91	86
NOSAC TASCO	1	51
NOSAC TRIGGER	37	92
NOSIRA SHARON	111	
NOVA EAGLE	29	
NUEVO SAN JUAN	31	145
NURNBERG EXPRESS	92	
OAXACA	82	45
OCEAN CHEER	17	
OCEAN COMMANDER *1	21	17
OCEAN LUCKY	21	110
OCEAN SEL	27	15
OCEAN STEELHEAD	23	116
OLEANDER	165	175
OLGA TOPIC	17	109
OLIVE ACE	18	
OMI CHAMPION	2	
OOCL AMERICA	14	
ORANGE ACE	1	
ORANGE BLOSSOM	70	215
ORANGE STAR	10	11
ORCHID	46	45
ORCHID *2	20	27
OREGON RAINBOW II	20	116
ORIENTAL DIPLOMAT	56	
ORIENTAL EXECUTIVE	111	205
ORIENTAL EXPLORER	24	134
ORIENTAL FAIR	68	51
ORIENTAL FAITH	49	
ORIENTAL FORTUNE	10	
ORIENTAL FREEDOM	104	
ORIENTAL FRIENDSHIP	62	171
ORIENTAL KNIGHT	13	
ORIENTAL MINISTER	8	
ORIENTAL PATRIOT	60	96
ORIENTAL PHOENIX		234
ORION HIGHWAY	60	69
OVERSEAS ALICE	5	7
OVERSEAS BOSTON		157
OVERSEAS CHICAGO	3	
OVERSEAS HARRIET	44	50
OVERSEAS JOYCE	39	
OVERSEAS VIVIAN	6	
OVERSEAS WASHINGTON	18	
PAC TRADER	4	8
PACBARON	7	
PACDUCHESS	182	89
PACEMPEROR	1	
PACGLORY	40	
PACIFIC ANGEL	24	
PACIFIC ARROW	106	93
PACIFIC DAWN	11	
PACIFIC PRINCESS	95	
PACIFIC RAINBOW	39	99
PACIFIC VICTORY	44	57
PACIFIC WING	17	
PACKING	29	35
PACMAJESTY	27	
PACMERCHANT	21	14
PACNOBLE	15	
PACPRINCE	33	
PACPRINCESS	9	8
PAN FORTUNE	17	12
PATRIOT	25	
PAUL BUCK	85	134
PECOS	51	71
PEGGY DOW	131	
PENNSYLANIA RAINBOW	46	80
PENNSYLVANIA TRADER	43	119
PERMEKE	1	
PERSEVERANCE	1	
PETERSFIELD	1	
PFC DEWAYNE T. WILLIAM	5	
PFC EUGENE A. OBREGON	10	13
PFC JAMES ANDERSON JR	13	
PHAROS	40	16
PHILIP R. CLARKE	31	45
PING CHAU	14	
POLAR ALASKA	1	177
POLYNESIA	224	97
POMEROL		37
POQUITA MAMI	57	178
PORTLAND	81	103
POTOMAC TRADER	21	105
PRESIDENT ADAMS	66	146
PRESIDENT ARTHUR	59	194
PRESIDENT BUCHANAN	71	134
PRESIDENT EISENHOWER	107	119
PRESIDENT F. ROOSEVELT	63	188
PRESIDENT GARFIELD	48	48
PRESIDENT GRANT	56	82
PRESIDENT HARDING	87	205
PRESIDENT HARRISON	57	59
PRESIDENT HOOVER	58	158
PRESIDENT JACKSON	53	138
PRESIDENT JEFFERSON	39	31
PRESIDENT KENNEDY	81	84
PRESIDENT LINCOLN	120	69
PRESIDENT MADISON	51	113
PRESIDENT MONROE	56	67
PRESIDENT POLK	94	200
PRESIDENT TYLER	59	162
PRESIDENT VAN BUREN	41	87
PRESIDENT WASHINGTON	123	42
PRIMORJE	1	
PRINCE OF TOKYO	94	241
PRINCE WILLIAM SOUND	24	
PRINCESS DIAN	35	48
PROJECT AMERICA	6	9
PUNTA BRAVA	15	36
PURITAN	159	
PUT HARRY FISHER	14	27
QUEEN ELIZABETH 2	21	
RAINBOW BRIDGE	62	42
RAINBOW HOPE	170	210
RALEIGH BAY	46	142
RANGER	71	29
RANI PADMINI		17
REGINA MAERSK	19	62
RESERVE	3	7
RHINE FOREST	34	70
RICH VICTORIA	30	
RICHARD G MATTIESEN	28	20
RIJEKA EXPRESS	43	
RIMBA KERUING	23	46
RIO ESQUEL	79	71
RIO FRIO	78	
RIO GRANDE	2	
RIO LIMAY	13	
RIVER ETERNITY		14
ROBERT CONRAD	239	280
ROBERT E. LEE	12	37
ROGER R. SIMONS	9	11
ROSARIO DEL MAR	4	
ROSETTA	78	105
ROSINA TOPIC	42	
ROTTERDAM	100	
ROVER	65	113
ROYAL PRINCESS	80	
ROYAL VIKING SKY	22	7
RUTH LYKES	28	32
SAM HOUSTON	31	
SAMAR VICTORY		103
SAMOAN REEFER	102	127
SAMRAT ASHOK	32	
SAMU	16	22
SAMUEL H. ARMACOST	23	29
SAN MARTIN I	77	
SAN MATEO VICTORY	13	57
SAN MIGUEL BAY	44	
SANKO DIGNITY	18	
SANKO LILY	6	
SANKO MOON	2	
SANKO PRELUDE	76	96
SANSINENA II	70	118
SANTA ADELA	46	95
SANTA CRUZ II	35	
SANTA JUANA	89	9
SANWA MARU	23	
SATURN DIAMOND	37	214
SAUDI DIRIYAH	4	
SAUDI HOFUF	27	
SAUDI RIYADH	31	
SAUDI TABUK	87	
SAVANNAH	103	
SCANDINAVIAN HIGHWAY	7	
SCARAB	24	56
SEA ACE	5	72
SEA BELLS	14	58
SEA DIAMOND	45	89
SEA FAN	40	146
SEA FORTUNE	49	224
SEA FOX	2	54
SEA LANTERN	48	164
SEA LIGHT	33	99
SEA LION	147	205
SEA QUEEN	5	
SEA TRADE	8	
SEA WOLF	272	43
SEALAND ANCHORAGE	28	109
SEALAND ATLANTIC	52	118
SEALAND CHALLENGER	53	111
SEALAND COMMITMENT	59	168
SEALAND CONSUMER	10	36
SEALAND CRUSADER	9	5
SEALAND DEFENDER	107	48
SEALAND DEVELOPER	50	100
SEALAND DISCOVERY	67	179
SEALAND ECONOMY	13	
SEALAND ENDURANCE	39	128
SEALAND ENTERPRISE	85	214
SEALAND EXPEDITION	26	72
SEALAND EXPLORER	70	148
SEALAND EXPRESS	75	80
SEALAND FREEDOM	73	204
SEALAND HAWAII	82	237
SEALAND INDEPENDENCE	37	130
SEALAND INNOVATOR	51	95
SEALAND KODIAK	34	90
SEALAND LIBERATOR	70	151
SEALAND MARINER	66	176
SEALAND NAVIGATOR	79	103
SEALAND PACIFIC	52	214
SEALAND PATRIOT	61	112
SEALAND PERFORMANCE	62	151
SEALAND PRODUCER	7	39
SEALAND QUALITY	39	170
SEALAND TACOMA	40	131
SEALAND TRADER	136	241
SEALAND VOYAGER	196	249
SEAWARD BAY	35	
SEDCO/BP 471	95	9
SENATOR		93
SEVEN OCEAN	60	26
SGT WILLIAM A BUTTON	2	
SGT. METEJ KOCAK	16	20
SHELDON LYKES	96	171
SHELLY BAY	6	11
SHENAHON	2	1
SHIN BEISHU MARU	44	
SHINKASHU MARU	97	
SIERRA MADRE	31	
SILVER CLIPPER	35	
SILVER VICTORY	53	89
SIOUX TATE	29	
SKAUBORD	46	112
SKAUGRAN	82	69
SKEENA	115	
SOLAR WING	68	140
SOMBAI	107	
SONORA	66	200
SOPHIA	57	
SOREN TOUBRO	9	
SOUTHWARD	1	
SPIRIT OF TEXAS	33	90
SPRING BEAR	7	
SPRING BEE	16	24
SPRING DELIGHT	1	
SPRING SWIFT	14	
SPRING VEGA	13	
STAR EAGLE	34	55
STAR ESPERANZA	51	76

Ship Name	radio	mail
STAR EVVIVA	29	81
STAR FLORIDA	84	
STAR GEIRANGER	6	6
STAR GRAN	54	51
STAR HONGKONG	50	
STAR MINERVA	27	70
STAR OF TEXAS	20	
STELLA LYKES	17	
STONEWALL JACKSON	19	16
STRATHCONON	62	
STRIDER ISIS	58	108
STUTTGART EXPRESS	52	
SUE LYKES	14	66
SUGAR ISLANDER	12	
SUN PRINCESS	53	
SUN VIKING	9	27
SUNBELT DIXIE	161	111
SUNNY SUPERIOR	12	175
SUSAK	4	
SWIFT TRADER	14	
SWIFTNES	55	78
TABASCO	56	78
TAI CHUNG		28
TAI CORN	8	
TAI LIENG	1	
TAMPA	2	
TARGET	40	140
TERESA O.		168
TEXACO NEW YORK	89	64
TFL ENTERPRISE	1	
THE PERFORMER	2	
THOMAS WASHINGTON	171	199
THOMPSON LYKES	26	106
THOMPSON PASS	30	71
TOBA	11	15
TOHZAN	13	18
TOKYO MARU	65	
TOLUCA	20	77
TONCI TOPIC	5	
TONSINA	63	141
TOWER BRIDGE	79	
TROPIC SUN	6	36
TROPICAL BEAUTY	33	81
TROPICALE	84	114
TRUDY	28	
TULSIDAS	49	
ULTRAMAR	8	48
ULTRASEA	27	
UNAMONTE	61	45
UNI-SPRING	53	229
UNI-SUPERB	10	7
UNIVERSE	16	
URTE	59	146
USCGC ACACIA (WLB406)	6	
USCGC ACTIVE WMEC 618	26	88
USCGC ALERT (WMEC 630)	10	
USCGC BISCAYNE BAY	1	8
USCGC BUTTONWOOD WLB 3	54	
USCGC CHEROKEE WMEC 16	99	190
USCGC CHILULA (WMEC 15	22	
USCGC CITRUS (WMEC 300	111	
USCGC CLOVER (WMEC 292	28	
USCGC CONIFIR(WLB 301)	4	
USCGC COURAGEOUS		64
USCGC DEPENDABLE	17	
USCGC ESCANABA	30	
USCGC EVERGREEN WMEC 2	7	
USCGC GALLATIN WHEC 72	7	
USCGC HAMILTON WHEC 71	1	
USCGC HARRIET LANE	7	35
USCGC IRONWOOD (WLB 29	81	43
USCGC JARVIS (WHEC 725	5	
USCGC MACKINAW	35	170
USCGC MALLOW (WLB 396)	1	
USCGC MESQUITE (WLB 30	5	23
USCGC MIDGETT (WHEC 72	2	
USCGC MORGENTHAU	122	
USCGC NEAH BAY	17	
USCGC NORTHLAND WMEC 9	3	
USCGC PLANETREE	15	13
USCGC POLAR SEA WAGB 1	248	228
USCGC RESOLUTE WMEC 62	26	
USCGC SEDGE (WLB 402)	13	
USCGC SPENCER	3	
USCGC STEADFAST WMEC 6	18	
USCGC STORIS (WMEC 38)	2	
USCGC SUNDEW (WLB 404)	10	
USCGC SWEETBRIER WLB 4	12	
USCGC TAHOMA	4	
USCGC TAMPA WMEC 902	1	53
USCGC THETIS	17	
USCGC VALIANT (WMEC 62	1	
USCGC VIGOROUS WMEC 62		132
USCGC YOCONA (WMEC 168	214	234
USNS A.J.HIGGINS		22
USNS ALTAIR	47	
USNS APACHE (T-ATF 172	3	
USNS CATAWABA	2	
USNS CHAUVENET	41	30
USNS GUS W. DARNELL	70	
USNS HARKNESS (T-AGS 3	1	106
USNS HENRY J. KAISER		89
USNS JOSHUA HUMPREYS	102	121
USNS KANE TAGS 27	4	
USNS KILAUEA	1	
USNS MERCURY	54	142
USNS MOHAWK (T-ATF 170	21	22
USNS NARRAGANSETT	60	83
USNS POLLUX	26	
USNS POWHATAN TATF 166	61	38
USNS RANGE SENTINEL	5	
USNS REDSTONE	3	
USNS RIGEL (T-AF 58)		108
USNS SATURN T-AFS-10		72
USNS SEALIFT ANTARCTIC	37	109
USNS SEALIFT ARABIAN S	79	130
USNS SEALIFT ARCTIC	41	29
USNS SEALIFT ATLANTIC	5	27
USNS SEALIFT CARIBBEAN	12	11
USNS SEALIFT CHINA SEA	32	91
USNS SEALIFT IND'N OCE	26	14
USNS SEALIFT MED	48	45
USNS SEALIFT PACIFIC	31	
USNS SIRIUS (T-AFS 8)		69
USNS SPICA (T-AFS 9)		50
USNS TRUCKEE (T-AO 147		25
USNS VANGUARD TAG 194	17	134
VALLEY FORGE	50	125
VAN HAWK	29	
VAN TRADER	48	151
VERRAZANO BRIDGE	111	100
VIRGO	71	205
VISHVA PALLAV	90	
VISHVA PANKAJ	24	
VISHVA PARAG	45	
VISHVA PRAFULLA	3	
VISHVA SHAKTI	4	
VISHVA SIDDHI	2	
WALCHAND	29	
WASHINGTON RAINBOW *2	22	99
WESER EXPRESS	33	
WESTWARD VENTURE	47	59
WESTWOOD ANETTE	99	203
WESTWOOD BELINDA		9
WESTWOOD CLEO	19	59
WESTWOOD JAGO	124	148
WESTWOOD MARIANNE	30	21
WESTWOOD MERCHANT		99
WESTWOOD MERIT	6	6
WESTWOOD MUSKETEER	14	24
WHITE ROSE	39	
WILFRED SYKES	29	19
WILHELM SCHULTE	32	125
WILLIAM E. MUSSMAN	27	67
WINTER SUN	45	
WINTER WAVE	53	42
WORLD WING *2	54	57
YAMAHIME MARU	6	
YAMATAKA MARU	65	
YANKEE CLIPPER	63	
YORKTOWN SEA	4	7
YOUNG SCOPE	43	
YOUNG SKIPPER	32	
YOUNG SPROUT	68	
ZEELANDIA	74	
ZEUS	8	
ZIM GENOVA	39	
ZIM HAIFA	48	
ZIM HONGKONG	25	
ZIM HOUSTON	27	
ZIM IBERIA	70	
ZIM KEELUNG	42	
ZIM MARSEILLES	26	
ZIM MIAMI	9	
ZIM NEW YORK	46	
ZIM SAVANNAH	31	
ZIM TOKYO	67	

GRAND TOTAL VIA RADIO 46378
UNIQUE RADIO OBS.25444 (31.7%)
GRAND TOTAL VIA MAIL 54707

TOTAL DUPLICATES 20934 (26.1%)
TOTAL UNIQUE OBS 80151
UNIQUE MAIL OBS. 33773 (42.1%)

Top Ships

Radio

NOAA Ship Miller Freeman
Gypsum King

Mail

NOAA Ship Miller Freeman
Lloyd Maranhao

January, February and March 1989

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
ACFT	6	6	0	AIRCRAFT
AAGO	8	8	0	***
A3BE	63	63	0	SAMI 11
A3BG	2	2	0	***
A3BZ	26	26	0	ACT 12
A8VI	63	63	0	PACDUCHESS
CGCL	25	0	25	BAFFIN
CGDU	103	103	0	W. TEMPLEMAN
CG2683	29	29	0	ALFRED NEEDLER
CG2958	49	0	49	TULLY
CSBL	16	16	0	DAMIAO DE GOIS
CXFN	21	21	0	PRESIDENTE REVIAA
C7C	104	0	104	OCEAN STATION CHARLIE
C7L	116	116	0	OCEAN STATION LIMA
DAKE	124	124	0	KOELN ATLANTIC
DA9100	165	165	0	***
DBBH	166	166	0	METEOR
DBFP	49	49	0	WALTHER HERWIG
DESI	61	39	22	VALDIVIA
DGLM	62	62	0	MONTE ROSA
DGUK	61	61	0	COLUMBUS VICTORIA
DGZU	51	51	0	COLUMBUS VIRGINIA
DGZU	4	4	0	***
DHCW	61	61	0	COLUMBUS WELLINGTON
DHJW	125	125	0	ACT 9
DHOU	30	30	0	PURITAN
DLEZ	20	20	0	YANKEE CLIPPER
DSCW	2	2	0	***
D5MD	17	17	0	SAINT LUCIA
D5ME	65	65	0	MT CABRITE
D5MZ	103	103	0	POLYNESIA
ELBX3	6	6	0	PACKING
ELDM8	33	33	0	SEAL ISLAND
ELED8	14	14	0	PACPRINCESS
EREA	133	116	17	MUSSON
EREB	158	140	18	VOLNA
EREC	120	10	110	PRILIV
EREH	93	0	93	PRIBOY
EREI	25	2	23	OKEAN
ERES	63	56	7	VICTOR BUGAEN
ERET	146	121	25	GEORGE OUSHAKOV
EREU	39	32	7	ERNST KRENKEL
ESGG	25	3	22	VYACHESLAV FROLOV
FAHR	1	1	0	***
FAUD	2	2	0	ENSEIGNE DE VAISSEAU
FNBA	90	90	0	CAYOS
FNZC	14	14	0	***
FNGB	13	13	0	MARION DUFRESNE
FNGS	71	71	0	LAFAYETTE
FNJT	67	67	0	KORRIGAN
FNMZ	35	35	0	CORIOLIS
FNOM	55	55	0	ANGO
FNPA	84	84	0	RONSARD
FNQB	20	20	0	ILE MARURICE
FNQC	73	73	0	VILLE DE ROUEN
FNQM	29	29	0	VILLE DE MARSEILLE
FNZO	41	41	0	RABELAIS
FNZP	52	52	0	RACINE
FNZQ	61	61	0	RIMBAUD
FPID	15	15	0	ROSPICO
FPYO	25	25	0	CAP SAINT PAUL
GACA	21	21	0	***
GDLS	40	40	0	DARWIN
GLNE	5	5	0	DISCOVERY
GOVL	25	25	0	ACT4
GOVN	9	9	0	ACT6
GVAW	16	16	0	ENCOUNTER BAY
GVSA	55	55	0	FLINDERS BAY
GVSE	10	10	0	BOTANY BAY
GZKA	32	32	0	ACT 3
HCGT	3	3	0	BUCCANEER
HPAN	5	5	0	MICRONESIAN COMMERCE
HPEW	51	51	0	PACIFIC ISLANDER
H9BQ	55	55	0	MICRONESIAN INDEPENDANCE
JBOA	27	27	0	KEIFU MARU
JBAA	26	26	0	JAPAN TUNA II
JCCX	104	104	0	CHOFU MARU
JCDF	70	70	0	SOYO MARU
JCDT	31	31	0	AMERICA MARU
JCIN	32	32	0	TOKYO MARU
JCOD	21	21	0	SHOYO
JDAD	8	8	0	SHOYU MARU
JDUX	100	100	0	***
JFCI	45	45	0	
JFDG	57	57	0	SHUNPU MARU
JGZK	114	114	0	RYOFU MARU
JJZC	35	35	0	HAKONE MARU
JNTO	7	7	0	***
JNVF	58	58	0	KAIYO MARU
JPJX	94	94	0	HAKURYU MARU
JPUB	79	79	0	SEIFU MARU
JSUY	5	5	0	SHIRASE
KGUU	24	24	0	TH. WASHINGTON
KIRH	22	22	0	SEALAND TRADER
KMBD	42	42	0	DELAWARE II
LTZI	4	4	0	***
L2TI	1	1	0	***
MAQD	2	2	0	JARVIS
MAVOCE	8	8	0	MAVOCEANO
MBMO	4	4	0	***
MOWA	38	38	0	MORGENTHAU
MEKF	22	22	0	LYNCH
MFKO	83	83	0	SEALIFT ARABIAN SEA
MLGF	43	43	0	NORTHLAND
MAJE	1	1	0	ESTROCIN
MMAS	7	7	0	***
MOCF	37	37	0	***
MOHW	2	2	0	***
MOST	93	93	0	SEALIFT ARCTIC
MAVO	62	62	0	POLAR SEA
MYCQ	5	5	0	BOUTWELL
OWEQ	2	2	0	MC KINNEY MAERSK
OWEQ2	3	3	0	***
OXFB2	5	5	0	***
OXMD	16	16	0	LAAS MAERSK
OXMD2	5	5	0	***
P6DG	69	69	0	MEDLLOYD KINGSTON
P6DS	56	56	0	MEDLLOYD KYOTO
P6DT	37	37	0	MEDLLOYD BALTIMORE
PGDV	47	47	0	MEDLLOYD BANGKOK
PGEH	1	1	0	MEDLLOYD BAHREIN
PGEM	8	8	0	MEDLLOYD BARCELONA
PJVG	46	46	0	OLEANDER
P3EU	42	42	0	WILHELM SCHULTE
SHIP	507	507	0	***
S6FK	18	18	0	SWAN REEFER
TFEA	27	27	0	BJARNI SAEMUNDSSON
UBNZ	39	39	0	SHULEYKIN AKADEMIK
UEAK	12	0	12	VALERIAN URYVAYEV
UHQS	221	8	213	AKADEMIK KOROLEV
UJFO	59	57	2	MULTANOVSKIY PROF
UMFW	66	66	0	PROF. ZUBOV
UMWZ	1	1	0	MIRNY
UPUI	33	33	0	PROFESSOR VIZE
UQHN	23	3	20	ABAKANLES
UQYC	2	2	0	AKADEMIK FEDOROV
USC6	6	6	0	U.S. COAST GUARD
USWN	26	0	26	SOLIDARNIY
UUPB	21	3	18	AKADEMIK N. SHOKALSKIY
UUQR	4	4	0	MOLCHANOV PAVEL PRO
UUMJ	5	5	0	VSEVOLOD BERYOZKIN
UUMM	88	67	21	GAKKEL, YAKOV
UWEC	125	15	110	PROFESSOR KHROMOV
UWFH	3	0	3	***
UZCB	78	63	15	***
UZGH	72	58	14	PASSAT
VCBT	23	23	0	CAPE ROGER
VCTF	10	10	0	CAPE BRIER
VC6178	5	5	0	***
VC9450	40	40	0	GADUS ATLANTICA
VJBQ	23	23	0	ANRO AUSTRALIA
VKCK	51	51	0	STUART
VKCN	33	33	0	CANBERRA
VKCV	80	80	0	DERWENT
VKDA	3	3	0	DARWIN
VKLC	15	15	0	BRISBANE
VKMK	17	17	0	SWAN
VKML	75	75	0	SNIPE
VKMN	23	23	0	TEALE
VKMS	289	289	0	COOK
VLHB	37	37	0	TORRENS
VXN8	155	155	0	AIRCRAFT
WCGN	39	39	0	CHEVRON CALIFORNIA
WECB	131	131	0	MELVILLE
WHBA	59	59	0	R.D.CONRAD
WMVF	39	39	0	ALBATROSS IV
WRA4560	11	11	0	BOLD VENTURE
WRBA	7	7	0	***
WRBB	8	8	0	***
WSD3628	27	27	0	ROYAL DAWN
WSE3385	102	102	0	GLORITA
WTDF	36	36	0	T. CROMWELL
WTDK	8	8	0	D.S. JORDAN
WTDM	63	63	0	M.FREEMAN
WTDO	7	7	0	OREGON II
WTEA	82	82	0	DISCOVERER
WTED	8	8	0	CHAPMAN
WTEF	1	1	0	RAINIER
WTEG	2	2	0	MOUNT MITCHELL
WTER	8	8	0	M. BALDRIDGE
WTES	65	65	0	SURVEYOR
WTEZ	5	5	0	FERREL
WUW9647	13	13	0	BARBRA H.
WXBR	35	35	0	CHEVRON MISSISSIPPI
WYR7512	17	17	0	BALD EAGLE
WYV65	1	1	0	DEFIANCE
WYV6568	30	30	0	DEFIANCE
WZE39	13	13	0	MOANA WAVE
ZCSK	54	54	0	SKEENA
ZCSL	45	45	0	NIMOS
ZMFS	9	9	0	***
3BDA	9	9	0	MAURITIUS
3EAB7	23	23	0	***
3EET4	38	38	0	SEAS EIFFEL
3EIX2	7	7	0	PRESIDENTE IBANEZ
3EZG5	24	24	0	HIKAWA II
3FHI2	100	100	0	MOANA PACIFIC
5MCB	6	6	0	PACMERCHANT
7JDU	168	168	0	MATSUSHIMA
7JJE	2	2	0	***
7JOB	50	50	0	SHINKASHU MARU
7JWN	35	35	0	TAKUYO
7KDD	20	20	0	YOKO MARU
9VUU	9	9	0	ANRO ASIA

TOTAL BATHYS RECEIVED 8232
TOTAL TESACS RECEIVED 976
TOTAL REPORTS RECEIVED 9208

January, February and March 1989

Wave observations are taken each hour during a 20-minute averaging period, with a sample taken every 0.67 seconds. The significant wave height is defined as the average height of the highest one-third of the waves during the hourly averaging period. The maximum significant wave height is the highest of those values for that month. At most stations, air temperature, water temperature, wind speed and direction are sampled once per second during an 8.0-minute averaging period each hour (moored buoys) and a 2.0-minute averaging period for fixed stations (C-MAN). Contact NDBC Data Systems Division, Bldg 1100, SSC, Mississippi 39529 or phone (601) 688-2838 for more details.

January 1989 STATION	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
Buoy													
32302	18.0S	085.1W	0737	20.6	20.9	1.8	3.6	01/21	9.7	NE	17.9	24/09	1014.4
41001	34.9N	072.9W	0743	16.3	20.6	2.7	10.3	04/14	18.4	SW	43.9	04/10	1019.7
41002	32.2N	075.3W	0546	19.9	22.1	2.3	8.6	04/11	14.4	S	40.0	04/09	1022.1
41006	29.3N	077.4W	0743	21.9	23.7	2.0	6.1	23/10	12.3	SE	38.1	23/10	1021.2
41008	30.7N	081.1W	0742	15.3	15.4	1.1	4.6	23/01	9.8	N	34.8	23/00	1021.8
41009	28.5N	080.2W	1476	21.2	22.7	1.3	5.9	22/07	11.3	SE	39.4	22/18	1022.0
41010	28.9N	078.5W	1482	22.0	23.8	1.8	6.2	23/07	13.8	SE	44.3	23/06	1021.6
42001	25.9N	089.7W	0406	23.3	24.0	1.0	5.2	21/12	10.1	SE	30.1	21/09	1020.2
42002	26.0N	093.5W	0742	22.3	23.5	1.2	4.3	21/03	12.7	SE	31.3	21/03	1019.5
42003	25.9N	085.9W	0743	22.3	24.2	1.0	3.9	22/09	10.1	SE	18.7	04/15	1021.0
42007	30.1N	088.8W	0738	15.2	16.0	0.5	1.3	10/16	10.8	NE	26.4	21/05	1022.4
42015	30.2N	088.2W	0740	15.0	15.9	0.6	1.4	14/22	9.4	NE	24.3	21/08	1022.4
44004	38.5N	070.6W	0743	9.1	13.3	2.4	7.5	21/14	15.5	NW	33.7	04/11	1020.0
44005	42.7N	068.6W	0742	2.2	5.6	2.2	6.0	21/19	14.7	NW	31.2	21/08	1018.6
44007	43.5N	070.1W	0740	-0.7	4.1	1.0	3.3	08/10	13.7	N	40.8	21/16	1017.3
44008	40.5N	069.5W	0743	3.7	5.7	2.0	5.1	05/03	17.2	NW	39.2	05/11	1018.8
44009	38.5N	074.6W	0500	6.0	6.7	1.0	2.7	24/09	12.5	NW	35.9	21/08	1022.3
44011	41.1N	066.6W	0744	3.8	5.5	2.6	7.5	21/23	13.6	NW	32.6	21/21	1017.9
44012	38.8N	074.6W	0709	4.9	6.3	1.0	2.7	07/08	13.1	NW	34.4	21/11	1021.0
44013	42.4N	070.8W	0330	-1.5	4.2	0.7	2.2	08/03	15.8	NW	34.2	05/00	1021.6
45002	45.3N	086.4W	0480	-0.4	3.2	1.3	4.8	22/02	18.4	SW	38.1	22/01	1015.5
46001	56.3N	148.3W	0742		4.7	4.1	8.3	13/07	17.6	W	30.7	30/04	1002.4
46002	42.5N	130.4W	0743	9.8	10.6	3.4	6.3	14/08	15.2	W	21.1	02/07	1026.4
46003	51.9N	155.9W	0125	3.4	3.5	4.3	9.2	08/18	22.1	W	36.0	12/15	1010.1
46005	46.1N	131.0W	0742	8.4	9.4	3.8	7.8	17/05	15.6	W	26.6	16/17	1021.6
46006	40.8N	137.6W	0740	11.4	12.8	3.1	6.5	14/04	16.8	W	30.3	13/03	1028.4
46010	46.2N	124.2W	0743	6.9	7.7	2.9	5.6	17/21	13.2	S	36.7	13/05	1021.2
46011	34.9N	120.9W	0744	10.8	11.4	2.2	5.2	01/00	7.7	NW	18.0	29/03	1022.1
46012	37.4N	122.7W	0741	10.3	10.7	2.1	4.5	01/02	11.8	N	19.4	03/09	1023.9
46013	38.2N	123.3W	0744	9.3	10.3	2.4	5.1	01/00	10.6	NW	32.9	10/23	1023.7
46014	39.2N	124.0W	0457	9.3	10.0	2.7	5.1	18/01	9.9	N	27.3	25/02	1022.6
46022	40.8N	124.5W	0743	8.2	9.1	3.0	5.9	01/02	9.6	N	24.4	13/13	1024.6
46023	34.3N	120.7W	0742	11.4	11.7	2.4	5.5	01/01	13.2	NW	30.6	25/08	1021.0
46025	33.7N	119.1W	0744	13.1	12.9	1.0	2.8	06/09	8.4	NW	30.2	06/09	1019.8
46026	37.8N	122.7W	0744	9.3	9.8	1.8	3.5	01/00	11.2	NW	32.3	10/23	1023.1
46028	35.8N	121.9W	0743	11.1	11.8	2.4	5.5	01/03	10.0	NW	28.0	11/12	1022.4
46030	40.4N	124.5W	0741	8.2	9.1	2.6	5.2	01/01	13.4	N	30.3	08/16	1023.9
46035	57.0N	177.7W	0714	-2.6	2.0	3.9	10.5	31/04	22.3	NE	42.4	04/18	1004.1
46040	44.8N	124.3W	0622	7.6	9.1	3.2	5.9	11/04	12.1	SW	33.2	13/07	1024.2
46042	36.8N	122.4W	0296	9.6	10.9	2.3	4.7	01/01	9.6	NW	23.3	11/00	1024.0
51001	23.4N	162.3W	0306	23.5	24.5	3.3	8.4	29/03	14.3	E	27.3	12/12	1017.4
51002	17.2N	157.8W	0534	24.0	25.2	3.1	5.7	01/09	17.6	E	30.7	01/12	1015.2
51003	19.2N	160.8W	0739	24.4	25.5	2.7	5.3	30/05	12.9	E	23.9	01/20	1014.2
51004	17.5N	152.6W	0743	23.6	24.4	2.9	6.3	10/12	16.0	E	28.4	10/11	1015.7
C-MAN													
ALSN6	40.5N	073.8W	0740	3.0	5.3				14.5	NW	44.1	21/10	1020.5
BURL1	28.9N	089.4W	0742	16.4					12.5	N	32.8	21/03	1020.7
BUZM3	41.4N	071.0W	0742	2.0					17.4	W	39.3	04/21	1018.9
CARO3	43.3N	124.4W	0743	7.0					8.6	S	30.0	10/03	1024.5
CHLV2	36.9N	075.7W	0742	7.3	7.3	1.0	2.8	04/20	14.4	N	43.5	04/09	1022.1
CLKN7	34.6N	076.5W	0743	11.1					11.8	N	33.8	04/08	1022.2
CSBF1	29.7N	085.4W	0741	15.9					5.9	E	18.3	04/02	1022.8
DBLN6	42.5N	079.4W	0743	0.2					15.7	SW	45.1	08/20	1019.0
DESW1	47.7N	124.5W	0741	5.8					13.4	SE	40.1	13/01	1020.0
DISW3	47.1N	090.7W	0644	-4.6					13.3	SW	40.7	27/02	1014.1
DPIA1	30.3N	088.1W	0741	14.8	15.0				10.3	N	27.6	04/04	1022.7
DSLN7	35.2N	075.3W	0743	13.7	19.7	1.8	5.9	23/17	19.1	W	50.5	04/07	1022.4
FARP2	8.6N	144.6E	0744	28.2					12.1	E	27.8	19/21	1008.1
FBIS1	32.7N	079.9W	0743	11.6					6.9	NE	24.0	14/08	1023.1
FFIA2	57.3N	133.6W	0742	0.5					18.1	SE	46.3	30/17	1005.4
FPSN7	33.5N	077.6W	0741	15.1					17.3	N	50.7	04/05	1022.2
GDIL1	29.3N	090.0W	0743	16.6	17.0				9.8	E	27.6	21/01	1020.9
GLLN6	43.9N	076.4W	0733	-1.9					16.9	W	42.1	08/22	1018.6
IOSN3	43.0N	070.6W	0742	0.1					15.9	W	42.7	21/11	1019.2
LKWF1	26.6N	080.0W	0743	22.3	23.5				8.8	SE	23.0	04/16	1020.8
MDRM1	44.0N	068.1W	0742	-0.6					19.2	NW	49.1	21/11	1016.6
MISM1	43.8N	068.9W	0743	-0.5					17.8	NW	42.1	21/09	1018.1
MLRF1	25.0N	080.4W	0743	23.2	24.5				11.1	E	27.8	22/23	1020.6
MPCL1	29.4N	088.6W	0707	17.7					13.0	NE	31.5	21/09	1022.3
NWPO3	44.6N	124.1W	0743	6.8					9.5	E	31.0	15/09	1023.6
PILM4	48.2N	088.4W	0742	-5.7					16.2	N	36.5	27/02	1014.7
PTAC1	39.0N	123.7W	0744	7.8					7.6	N	27.0	10/19	1023.5
PTAT2	27.8N	097.1W	0743	15.2					10.3	N	28.6	13/03	1019.8
PTGC1	34.6N	120.7W	0742	10.8					11.8	N	33.7	11/08	1021.6
SAUF1	29.9N	081.3W	0742	16.7	16.4				9.7	N	42.3	22/19	1022.7
SBIO1	41.6N	082.8W	0744	0.3					15.1	SW	39.6	08/19	1019.2
SGNW3	43.8N	087.7W	0741	-0.3					13.5	W	32.9	08/06	1016.1
SISW1	48.3N	122.8W	0744	5.5					10.2	SE	35.1	31/05	1019.3
SMKF1	24.6N	081.1W	0731	23.2	23.5				13.0	E	27.4	22/20	1021.0
SPGF1	26.7N	079.0W	0624	22.4	24.4				7.0	SE	21.3	23/09	1021.5
SRST2	29.7N	094.1W	0743	13.6					9.4	NE	22.6	09/08	1021.0
STDM4	47.2N	087.2W	0741	-3.5					18.2	NW	44.1	27/04	1013.9
SULS1	32.0N	080.7W	0744	13.3	13.3				13.2	NE	41.2	04/03	1022.5
TPLM2	38.9N	076.4W	0740	3.8	3.6				9.3	S	31.6	21/06	1021.7
TTIW1	48.4N	124.7W	0744	5.7					13.8	S	45.1	16/21	1019.5
VENF1	27.1N	082.5W	0737	18.6	20.2				6.4	E	22.4	04/10	1021.4
WPOW1	47.7N	122.4W	0728	6.1					11.0	S	34.4	17/01	1020.4

February 1989	STATION	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
Buoy														
	32302	18.0S	085.1W	0667	21.8	22.1	1.8	3.0	27/20	10.9	SE	16.7	21/22	1014.3
	41001	34.9N	072.9W	0671	15.9	20.2	2.5	6.7	25/08	16.9	SW	32.8	19/13	1019.8
	41002	32.2N	075.3W	0223	19.1	21.4	2.2	6.2	25/03	13.6	SW	29.5	24/15	1022.1
	41006	29.3N	077.4W	0670	21.0	23.9	1.8	6.0	24/15	12.3	S	30.6	24/02	1022.6
	41008	30.7N	081.1W	0665	14.2	16.0	0.9	2.9	17/18	10.6	S	29.9	24/05	1022.7
	41009	28.5N	080.2W	1331	19.5	22.6	1.2	2.7	24/09					1023.6
	41010	28.9N	078.5W	1338	20.6	23.8	1.6	4.4	24/04	13.2	S	35.0	24/00	1023.1
	42001	25.9N	089.7W	0224	22.0	24.7	1.3	5.2	23/03	13.1	NE	29.7	23/03	1021.9
	42002	26.0N	093.5W	0670	20.5	22.7	1.6	4.3	22/22	15.5	SE	29.0	22/20	1021.5
	42003	25.9N	085.9W	0669	20.6	22.9	1.2	4.9	23/16	13.0	E	29.0	23/22	1022.3
	42007	30.1N	088.8W	0666	12.8	15.9	0.6	1.3	09/13	11.7	N	28.4	23/03	1023.9
	42015	30.2N	088.2W	0668	12.9	15.8	0.6	1.6	21/07	10.8	N	27.4	23/05	1023.7
	44004	38.5N	070.6W	0669	8.8	14.9	2.5	7.6	25/02	16.0	N	39.4	25/00	1020.1
	44005	42.7N	068.6W	0670	0.2	4.3	2.1	6.0	25/13	13.9	SW	28.6	09/14	1020.4
	44007	43.5N	070.1W	0671	-2.7	3.2	1.0	3.1	25/11	12.8	N	33.0	09/11	1019.7
	44008	40.5N	069.5W	0669	2.3	4.7	2.0	6.0	24/21	16.3	NW	36.9	24/22	1019.8
	44009	38.5N	074.6W	0665	3.4	6.1	1.3	5.4	24/16					1021.6
	44011	41.1N	066.6W	0672	2.7	4.4	2.4	5.7	25/04	12.6	NW	29.0	27/11	1019.6
	44012	38.8N	074.6W	0658	2.8	5.4	1.2	4.5	24/15	15.5	N	38.7	25/00	1021.2
	44013	42.4N	070.8W	0354	-2.7	2.8	0.9	4.2	25/05	14.7	W	35.2	09/16	1018.0
	45002	45.3N	086.4W	0668	-7.2	1.6	1.1	3.2	25/03	17.0	W	34.0	08/15	1023.0
	46001	56.3N	148.3W	0671	2.2	3.5	2.3	4.9	28/04	11.0	SE	28.0	28/04	1032.6
	46002	42.5N	130.4W	0671	7.5	9.5	2.7	6.7	02/08	11.6	NW	24.6	23/04	1023.9
	46005	46.1N	131.0W	0672	5.9	8.2	2.5	6.7	01/06	12.4	N	28.7	01/08	1023.4
	46006	40.8N	137.6W	0664	9.3	12.1	2.8	7.0	24/04	15.6	NE	31.9	22/21	1024.3
	46010	46.2N	124.2W	0670	3.7	6.1	1.7	4.9	01/14	14.2	E	37.5	03/07	1022.2
	46011	34.9N	120.9W	0670	10.4	11.5	1.8	4.5	25/10	10.4	NW	32.0	08/23	1021.5
	46012	37.4N	122.7W	0668	9.1	10.8	1.7	3.5	25/03	9.7	NW	25.4	18/19	1022.8
	46013	38.2N	123.3W	0669	8.4	10.1	1.9	4.2	24/23	11.4	NW	29.5	28/01	1022.2
	46014	39.2N	124.0W	0670	8.4	10.2	2.1	5.1	02/08	11.2	N	29.7	28/03	1021.7
	46022	40.8N	124.5W	0670	7.7	9.3	2.2	5.1	02/01	10.0	N	25.5	22/09	1022.6
	46023	34.3N	120.7W	0669	10.7	11.6	2.0	4.0	09/01	14.8	NW	36.5	08/16	1020.5
	46025	33.7N	119.1W	0672	12.0	13.1	1.1	2.2	05/05	9.6	W	29.7	08/13	1019.8
	46026	37.8N	122.7W	0670	8.4	9.7	1.4	3.3	25/04	11.9	NW	30.9	28/04	1021.8
	46028	35.8N	121.9W	0668	10.3	11.6	2.0	4.2	25/07	10.9	NW	25.3	28/08	1021.6
	46030	40.4N	124.5W	0670	7.7	9.0	1.9	4.3	02/07	12.3	N	29.7	18/16	1021.9
	46035	57.0N	177.7W	0653	1.1	1.7	4.0	10.0	05/04	20.3	S	41.6	04/20	1006.4
	46040	44.8N	124.3W	0668	5.2	7.7	1.9	5.9	01/15	12.3	S	28.2	01/18	1022.8
	51001	23.4N	162.3W	0224	22.6	24.0	3.0	6.0	03/09	12.2	E	23.8	23/03	1015.3
	51002	17.2N	157.8W	0244	23.2	24.7	2.3	4.0	25/15	12.7	E	27.2	04/09	1015.0
	51003	19.2N	160.8W	0328	24.0	25.1	2.4	4.6	04/00	11.4	E	25.3	27/18	1013.3
	51004	17.5N	152.6W	0668	23.4	24.5	2.3	3.9	25/03	12.7	E	24.1	24/22	1015.7
C-MAN	ALSN6	40.5N	073.8W	0668	1.2	4.7				14.3	NW	40.1	21/18	1021.5
	BURL1	28.9N	089.4W	0672	13.8					13.9	N	28.5	09/06	1022.5
	BUZM3	41.4N	071.0W	0669						16.5	N	39.0	14/14	1020.3
	CARO3	43.3N	124.4W	0667	5.3					8.6	S	31.0	16/18	1022.8
	CHLV2	36.9N	075.7W	0656	5.7	6.8	1.2	4.9	24/19	17.3	N	44.4	24/12	1022.4
	CLKN7	34.6N	076.5W	0667	10.0					12.4	N	28.1	24/16	1022.2
	CSBF1	29.7N	085.4W	0671	14.6					6.7	N	19.0	27/15	1023.9
	DBLN6	42.5N	079.4W	0670	-4.4					12.4	SW	46.9	08/21	1022.7
	DESW1	47.7N	124.5W	0654	3.1					10.0	NE	39.1	22/22	1022.5
	DISW3	47.1N	090.7W	0582	-11.3					15.9	W	37.1	10/19	1023.3
	DPIA1	30.3N	088.1W	0669	12.6	13.8				12.2	N	28.5	09/13	1024.0
	DSLN7	35.2N	075.3W	0672	12.0	18.6	2.0	6.8	24/18	19.8	NE	45.5	24/14	1022.4
	FARP2	8.6N	144.6E	0672	28.1					9.1	E	23.6	25/09	1009.5
	FBIS1	32.7N	079.9W	0670	10.9					7.6	SW	28.0	17/04	1023.2
	FFIA2	57.3N	133.6W	0671	0.1					11.5	N	39.1	03/15	1031.9
	FPSN7	33.5N	077.6W	0669	14.2					17.7	SW	39.3	26/19	1022.3
	GDIL1	29.3N	090.0W	0669	13.9	15.8				10.6	N	29.9	09/08	1022.8
	GLLN6	43.9N	076.4W	0661	-5.2					13.7	W	40.4	08/22	1021.8
	IOSN3	43.0N	070.6W	0669	-2.0					15.1	W	42.6	09/15	1021.3
	LKWF1	26.6N	080.0W	0669	20.6	23.5				10.4	SE	23.0	09/22	1022.4
	MDRM1	44.0N	068.1W	0670	-2.7					18.4	NW	39.1	22/01	1019.1
	MISM1	43.8N	068.9W	0670	-2.8					17.3	NW	38.1	22/00	1020.5
	MLRF1	25.0N	080.4W	0669	21.8	24.0				12.9	E	27.6	22/13	1022.0
	MPCL1	29.4N	088.6W	0567	16.1					13.5	NE	32.8	23/00	1024.5
	NWPO3	44.6N	124.1W	0671	3.9					10.2	E	32.0	16/17	1022.9
	PILM4	48.2N	088.4W	0672	-11.8					17.4	W	38.5	12/22	1021.9
	PTAC1	39.0N	123.7W	0669	7.3					7.8	N	25.0	28/07	1021.9
	PTAT2	27.8N	097.1W	0666	12.3					12.5	N	27.2	03/13	1022.6
	PTGC1	34.6N	120.7W	0671	10.1					13.2	N	38.0	08/23	1021.2
	SAUF1	29.9N	081.3W	0668	15.0	16.6				9.3	N	30.0	18/01	1023.9
	SBIO1	41.6N	082.8W	0671	-3.9					12.1	SW	37.1	09/00	1023.5
	SGNW3	43.8N	087.7W	0669	-8.3					12.4	NW	28.5	02/10	1023.9
	SISW1	48.3N	122.8W	0672	2.5					8.2	N	30.0	01/07	1024.2
	SMKF1	24.6N	081.1W	0654	21.9	23.2				14.9	E	31.0	24/05	1022.5
	SPGF1	26.7N	079.0W	0665	21.6	24.5				8.2	SE	29.0	24/08	1022.9
	SRST2	29.7N	094.1W	0663	10.8					10.6	N	22.3	21/17	1023.5
	STDM4	47.2N	087.2W	0670	-8.8					20.1	NW	40.1	08/13	1020.9
	SULS1	32.0N	080.7W	0671	12.4	13.9				13.9	SW	37.7	17/09	1022.9
	TPLM2	38.9N	076.4W	0671	2.3	3.5				10.6	N	27.9	24/13	1022.2
	TTIW1	48.4N	124.7W	0672	3.2					16.0	E	49.1	03/06	1027.2
	VENF1	27.1N	082.5W	0663	17.5	20.4				7.9	E	32.4	24/00	1022.9
	WPOW1	47.7N	122.4W	0644	3.0					7.1	N	27.6	01/10	1024.5
	MARCH		1989											
Buoy														
	32302	18.0S	085.1W	0718	21.9	22.5	2.1	3.5	02/14	12.8	SE	21.6	30/10	1015.1
	41001	34.9N	072.9W	0742	17.3	19.3	2.4	6.0	11/01	17.1	SW	31.0	31/20	1018.9
	41002	32.2N	075.3W	0242	20.7	21.7	2.2	8.0	10/09	12.8	S	32.4	09/21	1019.3
	41006	29.3N	077.4W	0739	22.3	23.2	1.9	8.5	10/08	12.2	S	31.7	10/07	1018.5
	41008	30.7N	081.1W	0738	15.4	15.5	1.1	2.8	10/09	10.1	N	26.6	10/05	1018.4
	41009	28.5N	080.2W	1466	21.1	22.2	1.4	5.6	10/09	10.4	SE	21.8	23/22	1019.1
	41010	28.9N	078.5W	1470	22.1	23.1	1.8	7.9	10/09	13.5	S	41.4	09/19	1018.7
	42001	25.9N	089.7W	0109	20.4	23.9	1.5	3.9	06/00	7.8	SE	17.2	02/18	1017.1
	42002	26.0N	093.5W	0737	20.1	22.2	1.4	4.8	05/16	14.0	SE	32.6	22/10	1016.5
	42003	25.9N	085.9W	0737	21.2	23.7	1.1	3.4	07/00	11.6	SE	24.7	10/07	1017.4
	42007	30.1N	088.8W	0740	15.9	17.1	0.5	1.8	23/01	11.8	SE	30.3	22/01	1018.2
	42015	30.2N	088.2W	0742	16.0	17.3	0.6	2.2	05/22	10.5	SE	25.5	23/03	1018.2
	42016	30.2N	088.1W	0736	15.9	16.9	0.6	1.7	05/19	10.7	SE	27.4	22/01	1017.7
	44004	38.5N	070.6W	0740	10.3	12.4	2.5	6.0	09/08	16.0	NE	29.4	07/21	1020.3
	44005	42.7N	068.6W	0739	1.7	3.5	1.9	4.0	25/20	12.8	SW	26.8	21/13	1021.9
	44007	43.5N	070.1W	074,	0.1	2.0	1.0	3.0	30/23	13.0	N	27.2	14/08	1021.1
	44008	40.5N	069.5W	0737	4.2	5.1	1.9	4.0	08/19	16.8	NE	32.6	25/04	1020.7
	44009	38.5N	074.6W	0730	5.4	5.1	1.6	4.8	07/12	14.4	S	30.3	24/13	1020.8
	44011	41.1N	066.6W	0736	3.1	3.8	2.1	4.6	02/11	13.1	NE	24.0	25/22	1021.2
	44012	38.8N	074.6W	0046	2.8	4.2	0.8	1.5	01/04	11.4	W	18.5	01/19	1022.2

March 1989 STATION	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
44013	42.4N	070.8W	0734	1.8	2.7	0.9	3.5	25/13	13.6	NE	32.8	25/10	1021.6
45002	45.3N	086.4W	0107	-10.4	0.5	0.6	1.6	04/00	21.1	NE	34.8	04/02	1022.4
45007	42.7N	087.1W	0098	3.0	2.7	0.8	1.8	29/16	12.7	N	19.0	31/09	1013.2
46001	56.3N	148.3W	0739	2.2	3.2	2.7	8.5	03/12	12.4	N	31.1	03/20	1008.1
46002	42.5N	130.4W	0741	8.8	9.5	3.0	6.3	27/18	13.3	SW	31.3	04/13	1013.1
46005	46.1N	131.0W	0741	7.0	7.8	3.0	7.0	04/21	13.4	SW	30.0	04/19	1009.8
46006	40.8N	137.6W	0739	9.7	11.5	3.1	6.3	27/03	16.6	W	32.1	31/23	1012.2
46010	46.2N	124.2W	0736	7.4	8.2	2.4	5.8	06/02	14.4	S	34.2	09/22	1013.0
46011	34.9N	120.9W	0742	11.6	11.4	1.9	4.5	29/02	13.8	NW	28.6	14/03	1019.1
46012	37.4N	122.7W	0740	11.0	11.5	1.9	4.0	02/13	12.1	NW	29.9	02/08	1019.8
46013	38.2N	123.3W	0736	10.4	10.9	2.1	4.3	27/00	13.0	NW	27.7	03/03	1018.7
46014	39.2N	124.0W	0739	10.2	10.7	2.3	4.9	28/12	13.1	S	33.3	09/12	1017.5
46022	40.8N	124.5W	0738	9.7	9.9	2.5	5.3	28/09	12.7	S	37.6	09/16	1016.9
46023	34.3N	120.7W	0740	11.9	11.9	2.1	4.9	29/00	16.1	NW	28.8	14/09	1018.1
46025	33.7N	119.1W	0735	13.7	14.2	1.2	2.9	03/19	7.5	W	32.7	03/13	1016.9
46026	37.8N	122.7W	0741	10.7	11.2	1.7	3.8	28/16	13.3	S	35.0	02/09	1018.7
46027	41.8N	124.4W	0235	9.0	9.8	2.6	5.1	28/11	12.1	S	27.4	25/07	1018.7
46028	35.8N	121.9W	0741	11.8	12.1	2.1	4.6	27/08	11.5	NW	25.7	14/04	1019.2
46030	40.4N	124.5W	0741	9.7	9.8	2.4	5.4	26/23	15.4	SE	39.4	04/21	1016.6
46035	57.0N	177.7W	0719	-0.1	1.4	2.7	6.3	20/03	17.8	N	33.4	20/02	1016.0
46040	44.8N	124.3W	0739	8.0	8.6	2.6	7.5	05/23	13.7	S	35.6	09/22	1014.3
46041	47.4N	124.5W	0548	7.4	8.2	2.3	4.9	28/09	11.8	SE	29.1	27/01	1013.7
46042	36.8N	122.4W	0434	11.3	11.9	2.1	4.0	28/15	11.8	NW	24.7	24/10	1021.1
51001	23.4N	162.3W	0022	22.6	23.5	3.4	4.0	01/15	12.2	E	18.1	01/18	1002.6
51002	17.2N	157.8W	0247	23.9	24.9	2.0	3.1	24/15	12.6	E	23.2	06/21	1015.4
51003	19.2N	160.8W	0247	24.3	25.2	2.2	3.8	08/06	10.9	E	23.4	03/09	1014.9
51004	17.5N	152.6W	0739	23.9	24.9	2.1	3.2	08/00	12.2	NE	21.9	01/03	1016.0
52005	8.6N	144.5E	0107	26.3					0.5	E	1.5	28/03	1011.2
C-MAN ALSN6	40.5N	073.8W	0736	3.6	4.0				15.1	E	43.1	24/22	1021.3
BURL1	28.9N	089.4W	0740	15.9					13.6	E	33.1	23/02	1017.0
BUZM3	41.4N	071.0W	0741	2.2					16.7	N	35.2	25/03	1021.1
CARO3	43.3N	124.4W	0738	8.4					10.9	S	33.1	06/00	1015.4
CHLV2	36.9N	075.7W	0728	8.0	6.4	1.5	4.8	08/00	19.2	NE	37.8	08/00	1020.9
CLKN7	34.6N	076.5W	0732	11.8					12.0	N	27.8	09/14	1019.9
CSBF1	29.7N	085.4W	0740	17.0					6.9	SE	21.9	31/20	1018.7
DBLN6	42.5N	079.4W	0734	0.1					11.3	NE	41.8	15/15	1021.4
DESW1	47.7N	124.5W	0695	6.3					13.6	SE	40.1	05/02	1012.2
DISW3	47.1N	090.7W	0723	-6.0					11.3	NE	39.2	04/04	1021.3
DPIA1	30.3N	088.1W	0739	15.7	16.5				11.2	SE	30.5	22/01	1018.4
DSLN7	35.2N	075.3W	0736	13.4	13.9	2.1	6.6	08/06	20.3	SW	40.9	08/06	1019.6
FARP2	8.6N	144.6E	0735	27.8					7.9	E	20.9	14/07	1009.6
FBIS1	32.7N	079.9W	0731	12.5					9.5	NE	41.1	09/19	1019.8
FFIA2	57.3N	133.6W	0738	1.5					16.0	N	42.5	11/15	1010.3
FPSN7	33.5N	077.6W	0733	16.0					18.1	N	43.0	09/12	1019.5
GDIL1	29.3N	090.0W	0740	16.6	18.1				10.7	E	28.0	23/00	1017.1
GLLN6	43.9N	076.4W	0700	-2.1					12.0	NE	33.9	01/16	1022.0
IOSN3	43.0N	070.6W	0741	1.1					15.0	NE	37.1	25/09	1022.4
LKWF1	26.6N	080.0W	0734	21.6	23.0				9.8	SE	25.0	31/19	1018.0
MDRM1	44.0N	068.1W	0741	-0.4					17.1	N	40.1	25/12	1020.7
MISM1	43.8N	068.9W	0742	-0.4					16.3	N	35.1	30/20	1022.1
MLRF1	25.0N	080.4W	0741	22.4	23.6				11.7	SE	26.6	06/14	1018.0
MPCL1	29.4N	088.6W	0737	17.7					13.8	SE	41.2	23/03	1017.3
NWPO3	44.6N	124.1W	0738	7.8					10.7	SW	42.1	09/21	1014.7
PILM4	48.2N	088.4W	0712	-7.1					12.3	W	33.1	16/19	1022.5
PTAC1	39.0N	123.7W	0738	9.9					10.7	SE	30.0	09/13	1018.0
PTAT2	27.8N	097.1W	0739	15.5					11.3	SE	32.9	05/03	1016.7
PTGC1	34.6N	120.7W	0742	11.5					15.8	SW	39.3	02/15	1018.8
ROAM4	47.9N	089.3W	0022	-2.0					11.9	N	22.2	31/03	1016.5
SAUF1	29.9N	081.3W	0737	17.5	16.7				10.0	N	31.1	08/22	1019.3
SBIO1	41.6N	082.8W	0732	0.8					11.2	E	36.5	15/02	1020.8
SGNW3	43.8N	087.7W	0723	-2.1					12.0	S	31.0	03/21	1020.7
SISW1	48.3N	122.8W	0739	6.0					10.0	SE	36.1	27/04	1012.8
SMKF1	24.6N	081.1W	0723	22.6	23.1				12.1	E	26.7	11/02	1018.4
SPGF1	26.7N	079.0W	0741	23.0	24.5				7.4	S	29.7	10/05	1018.6
SRST2	29.7N	094.1W	0736	14.3					10.5	SE	24.2	05/18	1017.4
STDM4	47.2N	087.2W	0741	-5.6					15.7	N	41.1	15/06	1021.2
SVLS1	32.0N	080.7W	0743	13.5	13.3				15.1	NE	34.9	23/10	1019.0
TPLM2	38.9N	076.4W	0742	5.5	5.0				12.0	N	26.7	18/19	1021.2
TTIW1	48.4N	124.7W	0739	5.9					15.5	E	38.1	01/15	1012.9
VENF1	27.1N	082.5W	0736	19.3	20.7				8.0	S	22.0	23/16	1018.4
WPOW1	47.7N	122.4W	0738	6.4					9.7	S	26.6	21/14	1013.6

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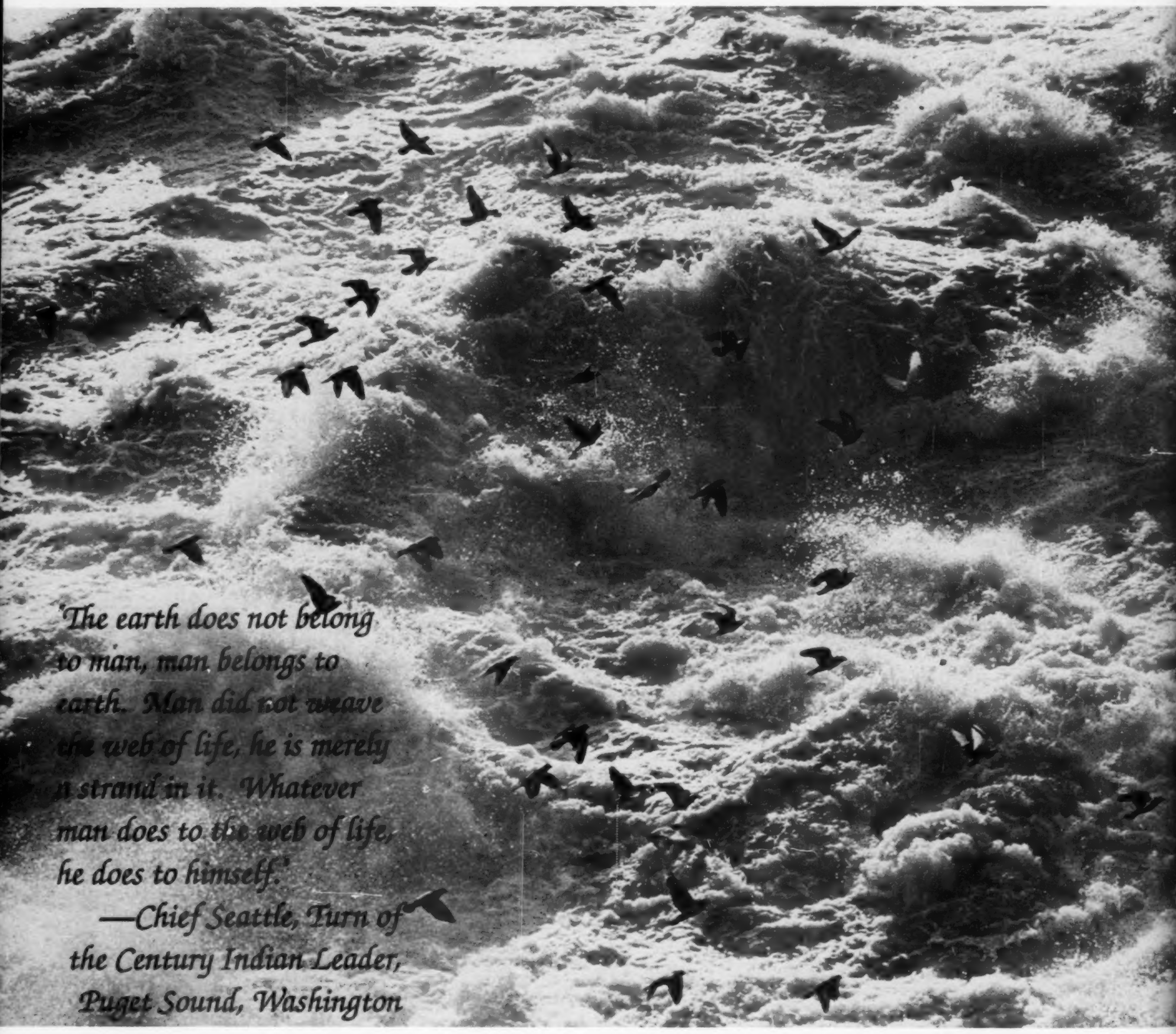

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